



CANADA

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

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BULLETIN No. 164

THE TERRESTRIAL CRYPTOGRAMS  
OF NORTHERN ELLESMERE ISLAND

By

Rudolf M. Schuster

William C. Steere

John W. Thomson

1959

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Issued under the authority of  
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# THE TERRESTRIAL CRYPTOGRAMS OF NORTHERN ELLESMERE ISLAND

## INTRODUCTION

RUDOLF M. SCHUSTER<sup>1</sup>

This report on the Bryophyta and Lichenes of northern Ellesmere Island is based on collections made by the senior author from May 18 to September 7, 1955, in the vicinity of Alert between lat. 82° 22' and 82° 32' N. and long. 62° 00' and 65° 30' W. Forty-three species and six varieties of Hepaticae, 105 species and three varieties of Musci, and 109 species and five varieties of Lichenes are recorded herein. Several of these are new to science; a considerable number are new to North America, and a very large number have not been previously reported from the Canadian Arctic Archipelago.

The field work was made possible by a Fellowship from the John Simon Guggenheim Foundation and a grant from the National Science Foundation (No. 669); by the co-operation of the Arctic Weather Stations, operated jointly by Canada and the United States; and by the Royal Canadian Air Force and the United States Air Force providing the transportation. The senior author is grateful to his wife, Olga M. Schuster, for her assistance in the preparation of the manuscript.

Collections of Bryophyta from the northern portions of Ellesmere Island ("Grant Land") have been few and usually made by non-botanists in a haphazard manner. The earliest collection was that made by the British Arctic Expedition under Sir George Nares (hereafter referred to as the "Nares Expedition") of 1875-76. One of the two ships of this expedition, the "*Alert*," wintered at Floeberg Beach, near Cape Sheridan, some ten miles east of the present Alert Weather Station. Captain H. W. Feilden, the naturalist on the Nares Expedition, made the first known collection of plants from this area. Hart (1880) listed 37 species of vascular plants from north of the 82nd parallel, from this collection. Mitten (*in* Nares, 1878) listed 46 species of mosses collected by the expedition, of which only 20 were from north of the 82nd parallel; he also listed *Blepharostoma trichophyllum* (sub. *Blepharozia trichophylla*), from Parry's Sound, to the south, the first report of an hepatic from Ellesmere Island.

Following the Nares Expedition, there was no further collecting in the region until Peary visited the area in conjunction with his several attempts to reach the North Pole. His ship, the "*Roosevelt*," wintered twice (1905-1906, 1908-1909) at Cape Sheridan. The scientific results of Peary's polar expeditions were extremely sparse, confined botanically to a few collections made by L. J. Wolf (1906), R. A. Bartlett (1908), and Dr. J. W. Goodsell (1909). Rydberg (1911-1912) lists the few angiosperms gathered by Wolf and Goodsell, adding only five species not previously collected by the Nares Expedition. The results of the Bartlett collections apparently have never been published, with the exception of the citations in Polunin (1940),

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which add five species of vascular plants to the area. The very few bryophytes collected on the various Peary expeditions were reported by Bryhn (1908), and include only a few species of mosses and two species of hepatics (*Diplophyllum incurvum* = *Scapania gymnostomophila*, and *Lophozia ventricosa*, both from Wrangel Bay, at lat. 82° N.). Of the mosses listed by Bryhn, most species had been previously listed from the area by Mitten (1878). A very small collection made on the north shore of Ellesmere Island by Wolf in 1906 was reported by Williams (1918). Thus, previous to this study, less than 40 species of mosses and two species of hepatics were known from northern Grant Land, north of latitude 82°. Bruggemann and Calder (1953) have compiled the scattered data on the vascular plants collected in the area, amounting to about 50 species; Bruggemann spent the summer of 1951 in the Alert region and published with Calder a carefully annotated list of 56 species from this area. This total is expanded to about 72 species in Porsild's *Flora* (1957). The total land flora previously reported, therefore, included less than 120 species from the area lying north of the 82nd parallel, exclusive of lichens.

This total stands in contrast with the relatively rich flora reported from more southerly parts of Ellesmere Island. Although several bryophytes were reported from southern and central Ellesmere Island (King Oscar Land, Grinnell Land, etc.) before 1880 (Steere, 1948), the first sizable collection was made by members of Lt. A. W. Greeley's Expedition at Lady Franklin Bay, just south of the area under discussion here. The bulk of the collection was unfortunately lost, but a few specimens were brought out in Greeley's private collection. The mosses, identified by the Rev. E. Lehnert of Washington, D.C., were published on by Greeley (1886, 1888). As Steere (1948) has shown, Lehnert's determinations are "so full of obvious errors that none of the specimens can be cited with security." Fortunately, soon thereafter, the Second "*Fram*" Expedition (1898-1902) explored almost the entire coast of Ellesmere Island, except for the northern portions discussed here. Although only 115 species of vascular plants are reported (Simmons, 1906), more than twice as many bryophytes are listed by Bryhn (1906-1907; see also Rydberg, 1908). A total of 290 species are listed, 57 of them hepatics, 233 mosses, of which a relatively small number belong in the doubtful category. A few species have been added by Harmsen and Seidenfaden (1932) from Craig Harbour in southeastern Ellesmere Island.

General accounts of the vegetation and physiography of the Arctic Archipelago, or of portions of it, are contained in Simmons (1906, 1913), Bruggemann and Calder (1953), and Porsild (1955, 1957). The paper by Bruggemann and Calder applies exactly to the area investigated; hence the following discussion is much condensed.

The Alert area lies almost 1,500 miles north of the southern end of Baffin Island. Ellesmere Island itself extends northward barely 40 miles beyond the area investigated, and the northern tip of Greenland extends northward only 40 miles farther.

The Alert region has a low relief, except at the western edges. The area from 63° W. eastward slopes gradually to the shore, about 1.5 to 2 miles from the coastline rising gradually to a plateau some 500 to 700 feet high. This plateau is deeply dissected ending southward in a series of low hills of which the more conspicuous are Mt. Pullen and The Dean (respectively 1,650 and 1,200 feet high). These hills, as well as all other



hilly terrain investigated, are rounded, strongly weathered, and largely covered by unconsolidated scree, except for their firn-ice-filled valleys, and (in a few instances) small valley glaciers.

The area to the west of Alert develops sharper relief; two deep bays to the immediate west, Colan Bay and Black Cliffs Bay (the latter extending southwestward as a long arm, Hilgard Bay), are fringed by steep hills rising 500 to 1,000 feet, rarely 1,250, above the shoreline. These hills are cut by narrow ravines with hanging valleys; they end in occasional crags but are largely covered by steep scree slopes. To the southwest of these two bays and the peripheral hills, the land becomes steeper, rising to two low mountains ("Peaks 1 and 2" in the following discussion) that attain a height of between 2,000 and 3,000 feet. These mountains constitute easterly outliers of the United States Range, lying to the southwest, a series of sharp peaks culminating in Mt. Grant, about 6,800 feet high. Although permanent ice, particularly in the valleys, is locally frequent, and numerous areas of persistent snow occur on steep slopes, extensive glaciers are absent except in the region of the United States Range, where an ice-cap probably of about 300 square miles, exists. The higher peaks project through this as nunataks.

To the north lies the frozen Lincoln Sea, only a narrow strip (usually 5-50 feet) of which, adjoining the shore, becomes ice-free, except when strong winds temporarily move the ice northward.

The area shows great uniformity geologically; the basic bed-rock consists of metamorphosed, strongly calcareous sediments, the "Cape Rawson beds," believed to be Palæozoic in origin. The slates and shales are greatly folded and contorted, often standing nearly vertical; because of severe and rapid weathering the bed-rock is usually evident only in the ravines, and even there it is difficult to locate. The rocks at higher elevations (800-1,600 feet or more) are often harder, forming loose scree slopes. At lower elevations the rocks appear to be more strongly calcareous, are softer, and weather rapidly into clays. The clay beds accumulating on low, level ground and gentle slopes often form polygons; on somewhat steeper slopes the clays (with incorporated slate fragments) frequently form unstable solifluction slopes. Run-off during the snowmelt period often results in rapid erosion.

In low-lying areas near shore, at elevations up to several hundred feet, shells of the common marine clam (*Mya truncata*) are found, and beds of marine clays and silts occur, in which these shells are embedded. Dickie (*in* Nares, 1878, p. 323) reports that Moss and Feilden, of the Nares Expedition, found stems of the kelp *Laminaria* from the mud of "a raised beach or shell flat 200 feet above the present level of the sea at Floeberg Beach . . . and Captain Feilden states that they retained the peculiar marine smell as strongly as in recent specimens." Evidence for recent emersion of the coastal region is also offered by the occurrence of stepped gravel outwash plains, as above Hilgard Bay, and in the occurrence of rounded pebbles and boulders at 400 to 500 feet.

One of the senior author's primary objectives was to accumulate phytogeographic evidence as to possible local lack of glaciation. Recent texts comment on the absence of detailed information as to glaciation in the area peripheral to the polar basin. The absence of continental



glaciation in the northernmost tip of Greenland appears well established and is indicated on the glacial map published by the American Geographical Society. At one time much of the area of the eastern Canadian Arctic was considered to have escaped glaciation (Fernald, 1925). Indeed, Sharp (1939) gives a map in which almost all of the eastern Canadian Archipelago is indicated as not having undergone Pleistocene glaciation. The author (Schuster, 1951), following these workers, also assumed that glaciation was absent in parts of the area. However, it appears that much of the region previously considered to have escaped glaciation was thoroughly glaciated. Bruggemann (*in* Bruggemann and Calder, 1953) is of the impression that "no unmistakable signs of glaciation" are observable. The native rocks are too soft, and weathering is too rapid and severe for the retention of glacial striae; glacial cirques are lacking, as are trough-shaped valleys. The general contour of the land in the area east of the ice-cap of the United States Range—the rounded or flat-topped mountains and hills, the deep, V-shaped valleys—suggests an "old" topography, largely the result of erosion and weathering. Glaciation in the Alert area was very probably local and incomplete, with at best thin ice-sheets that probably left nunataks exposed.

Collecting experience during the summer of 1955 did not lead to definite conclusions, based on phytogeography, as to the presence or absence of continental glaciation in northeastern Ellesmere Island. However, the discovery of well-marked new species of Hepaticae (*Tritomaria heterophylla*, *Lophozia pellucida*, *Scapania polaris*) indicates that endemic species may occur there. The fact that the single new species of moss, *Cratoneuron arcticum*, recurs in the unglaciated northern portions of Alaska but is not yet known from other portions of the arctic may also have phytogeographic significance. Perhaps equally suggestive is that several species of mosses reported largely from the unglaciated or locally glaciated portions of western North America but previously unknown from the Arctic Archipelago, have been found in collections made near Alert. Among these are, (1) *Mielichhoferia mielichhoferiana*, a species previously reported from Canada only from the shore of Lake Superior where "critical" species occur (Fernald, 1925, 1935; Schuster, 1953, 1958b); it has also been collected by Steere in unglaciated northern Alaska but apparently is unknown from elsewhere in arctic North America; (2) *Hygrohypnum alpestre*, a species which is known in the Western Hemisphere only from Alaska, Yukon, and Greenland; (3) *Grimmia tenuicaulis*, previously known to occur in the Yukon, Great Bear Lake, British Columbia, Alberta, Montana, and Wyoming, as well as arctic, unglaciated Alaska; (4) *Grimmia alpestris*, a rare and sporadically ranging arctic species, known previously from Greenland, but not from the Arctic Archipelago; and (5) *Fissidens arcticus*, known from West Greenland, several stations to the south in Ellesmere Island, and unglaciated arctic Alaska. The fact that a number of these arctic disjuncts also occur on the Greenland coast, of which small portions appear to have escaped continental glaciation, and in unglaciated arctic Alaska may suggest that parts of northern Ellesmere may also have escaped "continental" glaciation, although it appears probable that most of the northern coast was strongly, if locally, glaciated.

Perhaps also suggestive is that several of the "disjunct" species described by the author from the Lake Superior area have been discovered



in the Alert area but are not known elsewhere in North America. Among these species are *Lophozia latifolia* and *Cryptocolea imbricata*. Collections from intervening areas are needed before such a distribution pattern becomes meaningful.

The climate of the Alert area is rigorous, but less so than one would expect from the very high latitude. The winters are somewhat less severe than would seem indicated by the fact that the summer temperature usually hovers little above the freezing point. Alert lies at the shore of a large body of water, which, although essentially permanently frozen, nevertheless serves to ameliorate climatic conditions to some extent. The climate in northeastern Ellesmere Island, therefore, is somewhat more "oceanic" than at such interior stations as Eureka, which lies over 300 miles to the southwest. Although the summers are cooler, the winters show slightly higher minima, hence there is less maximal fluctuation in temperature.

During the long winter period, the monthly mean temperatures run about  $-23^{\circ}$  to  $-33^{\circ}$  F. (during the coldest January–March period), with lowest recorded winter minima varying about  $-49^{\circ}$  to  $-54^{\circ 1}$ . Although the mean temperature runs quite low, the absolute minima recorded at Alert are  $6^{\circ}$  to  $13^{\circ}$  higher than those at Eureka. Inversely, the summer temperatures are quite low. In the June–August quarter, temperatures averaged (mean daily temperature) about  $31^{\circ}$  to  $39^{\circ}$ , occasionally exceeding  $40^{\circ}$  and rising to  $47^{\circ}$  to  $51^{\circ}$  for two to three days each summer, although temperatures as high as  $61^{\circ}$  to  $64^{\circ}$  have been recorded. During the summer of 1955, which was somewhat cooler than usual (with almost all of July overcast), the July mean was  $33.1^{\circ}$  and the maximum was  $49^{\circ}$ . The maximal temperature in 1955 was  $52^{\circ}$ —reached, surprisingly, in June.

Although precipitation averages no more than 6 to 8 inches per year, the evaporation rate is very low, and humidity, furthermore, is always high, averaging usually between 80 and 100 per cent. During July 1955, there were approximately 9 inches of snowfall and about 0.09 inches of rainfall at the weather station. There was clearly more precipitation, in the form of snow, in the hilly terrain to the south and west.

Another factor makes possible extensive local development of vegetation: the accumulation of snow during the winter in deep drifts, which rarely, if ever, wholly disappear. The cores of these drifts are firn-ice which melts slowly during the summer, irrigating areas during the whole growing season. On slopes or ridges which are windswept, the sparse snow cover disappears rapidly in the spring, and such slopes or ridges may dry rapidly thereafter, in spite of the high humidity.

Despite low prevailing air temperatures during the short summer, progression of vegetation is phenomenally rapid. Snow-melt, falling at about middle (sometimes late) June is swift, once initiated; within a few days the Purple Saxifrage (*S. oppositifolia*) is in full flower, and within a week the Arctic Willow (*Salix arctica*) flowers. This must be partly a consequence of the fact that, with 24 hours of insolation, the ground warms up swiftly, and ground temperatures at the surface must run consid-

<sup>1</sup>The Nares Expedition, wintering about ten miles to the east, at Floeberg Beach, recorded minima of  $-67^{\circ}$  for February and  $-74^{\circ}$  for March. Such extreme minima have never been reported from the Alert Weather Station. It is possible that the earlier thermometers were not fully accurate at such low temperatures.



erably higher than the air temperatures. The relatively rich cryptogamic flora reflects, to some extent, the fact that the microclimate at ground level is much less rigorous than the air temperatures reported.

On a conservative estimate, more than 90 per cent of the area around Alert is almost devoid of plant cover; as emphasized by Bruggemann and Calder (1953), "the patches of closed vegetation occupy only a small fraction of one per cent of the total land surface of the district under discussion." Such patches of closed vegetation, furthermore, are restricted to a very few, localized areas, mostly lying near persistent snowdrifts. In the regions where such a supply of moisture is not available, the fast-drying clay and clay-shale flats and slopes are extremely barren. On gentle slopes, usually snow-free by mid-June, the scanty cover consists largely of *Saxifraga oppositifolia*, *Salix arctica*, and occasionally *Dryas integrifolia*, and, more rarely, clumps of *Cerastium alpinum* and *Draba alpina*.

To the interior, leaving the low-lying and more nearly flat plateau area, the hills and lower mountains present an even more sterile aspect. Except for the lower slopes, even the lower hills, such as Mt. Pullen and The Dean immediately south of Alert, are almost devoid of noticeable vegetation, a few lichens and mosses excepted. The steep slopes consist entirely or almost entirely of unconsolidated loose scree, the result of severe weathering. On such rocky slopes vegetation is developed only locally, adjacent to permanent snowbanks and below firn-ice-filled valleys; the plant cover, such as it is, consists almost entirely of lichens and mosses.

A notable feature of the area is the late snow-melt, occurring generally during or just before the middle of June. As a consequence, only a limited amount of collecting could be done between June 3 and June 13, in the immediate vicinity of the weather station on locally exposed, wind-blown slopes. However, because of the low level of precipitation and the high winds during the long winters, considerable areas with exceedingly sparse plant cover are essentially snow-free as early as the end of May, perhaps earlier; some of these are perhaps never snow-covered for extended periods, even during the winter. On these areas the only conspicuous angiosperm is *Saxifraga oppositifolia*; in run-off crevices on the slopes are found small patches of mosses in which *Dryas integrifolia* and *Salix arctica* may become established. Here are found, exposed by June 3, a very few species of mosses almost ubiquitous in the area (*Holmgrenia chrysea*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Pohlia cruda*, *Barbula icmadophila*, *Encalypta rhabdocarpa*, *E. procera*, *E. alpina*, etc.) and a few calciphilous hepatics (*Arnellia fennica*, *Cephaloziella arctica*). On the same date a few localized moist areas on rocky clay-shale slopes were partly free of snow; on them were found such mosses as *Mnium orthorhynchum*, *Ditrichum flexicaule*, *Myurella tenerrima*, *Cirriphyllum cirrosum*, *Tortula ruralis*, *Anoetangium tenuinerve*, *Distichium capillaceum*, *Encalypta procera*, *E. alpina*, *Barbula icmadophila*, *Timmia austriaca*, *Amblystegiella sprucei*, and hepatics such as *Sauteria alpina* and *Arnellia fennica*. By June 9 limited snow-melt had exposed small areas of sloping moss-tundra adjoining intermittent streams that dissect the plateau immediately south of Alert; in the moss-tundra between rocks and boulders along such streams occurred a number of hardy mosses (i.e., *Hypnum revolutum*, *Distichium capillaceum*, *Timmia austriaca*, *Barbula icmadophila*, *Ditrichum flexicaule*, less often *Tortula*



*ruralis* and *Mnium hymenophyllum*) and rather ubiquitous calciphilous hepatics (*Arnellia fennica*, *Scapania gymnostomophila*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Solenostoma polaris*). Most mosses and hepatics exposed at this early date are common arctic calciphiles.

The first important collections made were those immediately after surprisingly warm weather during the second week of June, when a maximal temperature of 52°F. was reached; the more shallowly snow-covered slopes then began to be extensively exposed. On June 16, the northern slopes of Mt. Pullen and the intervening terrain south of Parr Inlet were investigated; the only angiosperm in flower then was *Saxifraga oppositifolia*, which had been noted in flower just two days earlier. On June 24, the small mountain known as The Dean, immediately east of Mt. Pullen, was investigated. By then, *Salix arctica* and *Ranunculus sulphureus* were in flower. However, snow and a bitterly cold northwestern wind limited collecting. On succeeding days, fresh snow cover made collecting impossible, but by June 28 the snow had again vanished, except where deep drifts occurred. A trip was then made about three miles west to the headland northeast of Colan Bay, south of Williams Island; then the first plants of *Cerastium alpinum*, *Oxyria digyna*, *Draba bellii*, and *Carex misandra* were found in flower, although the north-facing slopes were still covered in places with snowdrifts up to 30 feet deep.

The first attempt at extensive field work was made on July 5, when a trip to the outlying portions of the United States Range was attempted. During the day, weather conditions progressively deteriorated, with flurries of snow and reduced visibility; the southern end of Hilgard Bay (lat. 82°26', long. 63°25') served as a bivouac. Next morning visibility was so reduced (and essentially lacking at over 500 feet elevation) that food and equipment, which had been carried along, were cached; only a limited amount of collecting was possible on the return to Alert. Toward evening heavy snow fell; for the following two weeks (until July 16) visibility at above 600 feet was greatly reduced. Intermittent snow and at times rain (at below 400 feet) were prevalent; Mt. Pullen and The Dean, 5 miles south of the station, only sporadically visible when breaks in the cloud cover and temporary cessation of snow occurred, gradually became snow-covered. Collecting, consequently, nearly came to a standstill during this period. The exceedingly unfavourable nature of the 1955 season is evident from the fact that at no time during the first sixteen days of July did the temperature exceed 40°F.; the mean daily temperature for the month was 29.9°F. Low temperatures and almost continual overcast resulted in the persistence of snowbanks and snowfields in sites where they presumably normally disappear by the middle of July. Off Cape Belknap, the ice showed little sign of breaking up; in Dumbbell Bay and Parr Inlet, near the weather station, the ice showed few fissures, and only a few small leads developed. Growth of angiosperm vegetation was greatly retarded; by July 5, at the south end of Hilgard Bay, the first individuals of *Papaver radicum* were in flower, as were those of *Saxifraga flagellaris*, *Cerastium alpinum*, and *Stellaria longipes*; red patches of *Oxyria digyna* were well-advanced, though the flowers were not yet at anthesis. The succeeding cold spell greatly inhibited further activity in the flowering season. However, despite a mean temperature averaging 30°F. and snow flurries, slow development of the vegetation continued. By July 15, well-vegetated slopes along the ice-covered sea



2.5 miles west of Cape Belknap, to the south of Williams Island, showed patches of *Pedicularis hirsuta* and *Eriophorum angustifolium* var. *triste* in full anthesis, and on the well-drained, fissured, and dry upper slopes, patches of *Dryas integrifolia* were in flower, whereas on damp clay-shale slopes patches of *Taraxacum phymatocarpum* and *Potentilla pulchella* were flowering. Development of the angiosperm vegetation thus progressed in spite of near-freezing air temperatures and extremely low insolation. During July there were 8.9 inches of snowfall at the weather station; at higher elevations to the south and west, where the majority of collecting sites occurred, snowfall was higher, and snow more persistent, limiting collecting largely to the immediate vicinity of Alert. On July 17, the shores of Cape Belknap were explored, along Dumbbell Bay and along the shore to the northwest; four days later, during a temporary break in the cloud cover, the slopes and summit of Mt. Pullen were investigated. Collecting proved excellent on the east-facing slopes below persisting snowbanks. On July 27 the slopes and summit of The Dean were again explored; collecting again was excellent. Subsequent inclement weather once more restricted field work until August 5, when a second attempt was made to penetrate to the United States Range. Limited collecting was done along Hilgard Bay, which was almost totally filled with ice, except for narrow shore water, and several hundred yards at its head (where the ice was dissipated owing to the influx of much meltwater through Hilgard River).

On August 6, the creek emptying into the head of Hilgard Bay was followed for a distance of about two miles. This creek (here called Hilgard River) runs almost due west at its mouth, then turns southward, and forks about 1.5 to 2 miles from its mouth with a large tributary running almost due west (this is referred to as the West Fork of Hilgard River), the creek proper flowing almost due north. Less than a mile from Hilgard Bay, where Hilgard River turns to the south, a conspicuous, relatively high, snow-clad mountain lying just west of Hilgard River and about 5 to 6 miles to the southwest of the head of Hilgard Bay becomes visible. This mountain, as viewed from the north from Hilgard Valley, has three peaks, the highest lying to the southeast or east; it probably rises to over 2,500 feet. Since it is conspicuously higher than the surrounding hills (elevation of the dissected plateau from which the peaks arise is given as over 2,000 feet in the "World Aeronautical Chart (8) Robeson Channel," 3rd Ed., 1953), it serves as a land mark for the surrounding terrain. This peak, climbed on August 6, is tentatively referred to as "Peak 1".<sup>1</sup>

The West Fork of Hilgard Creek was also explored; this extends at first almost due west or slightly northwest (direction approximate because of unreliability of compass readings), thus lying north or northeast of Peak 1; after about 1 to 1.5 miles it turns at almost right angles, going in a southwest direction (upstream), and lying thus directly to the northwest of the massif from which Peak 1 arises and draining its slopes. On following this stream and climbing the northwest slopes of Peak 1, a second peak, less acute, therefore less prominent, is in view directly to the southwest. This

<sup>1</sup>On the labelled specimens, already widely distributed, Peak 1 is referred to as "Mt. Olga" and Peak 2, as "Mt. Erica." These two names have been formally proposed for adoption to the Canadian Board on Geographical Names, and action on this proposal is pending. Since there is precedent for naming the outlying mountains of the United States Range for women (i.e., Mt. Julia), it was deemed proper to tentatively name these previously unclimbed mountains for the senior author's wife and daughter, respectively.



peak, scarcely lower, is referred to herein as "Peak 2."<sup>1</sup> A valley containing a shallow but rapidly running stream intervenes between Peak 2 and Peak 1; this stream is a tributary draining into the West Fork of Hilgard Creek. It is estimated that the elevation of the valley floor, which slopes steeply downward to the northwest (the direction in which the tributary runs), does not exceed 850 to 1,000 feet, except near its head.

To this point, only limited collections were made as the area was extraordinarily barren. A few lichens and mosses could be found on the northwest slopes of Peak 1 and several lichens in the stream-bed of the West Fork of Hilgard River, to the northwest of Peak 1. The upper slopes of Peak 1 may have provided better collecting grounds, especially the partly exposed, moss-covered, snow-fed scree slopes, but extensive snow cover virtually precluded collecting here. However, at lower elevations the sheltered valley between Peaks 1 and 2 provided reasonably good collecting, the snow-fed and highly calcareous clay-shale slopes being carpeted with mosses and, to a lesser degree, hepatics, particularly where irrigated by hanging snowbanks. Locally ubiquitous species such as *Arnellia fennica*, *Cephaloziella arctica*, and *Blepharostoma trichophyllum* ssp. *brevirete* were common; in addition, the damp, calcareous slopes sheltered many mosses, among them *Ditrichum flexicaule*, *Holmgrenia chrysea*, *Philonotis fontana*, *Timmia austriaca*, *Myurella julacea*, *Barbula icmadophila*, *Encalypta alpina*, *Distichium capillaceum*, *Polytrichum alpinum*, and *Didymodon recurvirostris*, among which grew the hepatic *Lophozia pellucida*.

The stream-bed was carpeted with swelling moss tufts, although hepatics were lacking. The thick moss-cover formed a matrix in which *Ranunculus sulphureus*, various grasses, and *Luzula* sp. grew in sparse colonies.

After this aforementioned region was investigated, the West Fork of Hilgard River was crossed, and a steep slope to the northwest, rising to an elevation estimated to be 1,800 to 2,000 feet, was climbed. Along a moss-fringed, small, steep rivulet 3 to 4 miles west of Peak 1, various angiosperms were collected, *Melandrium apetalum* being abundant and in full flower. The scree slopes above and to the west were locally snow-covered, the exposed portions almost barren, except for small patches of *Saxifraga oppositifolia*. On steep portions of such scree slopes *Rhacomitrium lanuginosum* and *Gymnomitrium concinnatum* were collected under conditions perfectly matching those on The Dean and Mt. Pullen where these species occur together.

A dissected plateau to the southwest was then explored; this plateau extends and gradually rises for some 12 to 16 miles to the west, until the high, snowclad peaks of the United States Range are attained. By August 7, a ridge which rises gradually to 2,500 to 3,000 feet to the southwest was reached. From this ridge the broad and deep valley of upper Wood Creek was visible some 2 to 3 miles to the northwest; directly to the west lay the United States Range, with pyramidal Mt. Grant some 10 miles to the west. The front range of the United States Mountains was about 5 to 6 miles distant.

On this ridge the lower, calcareous clay-shale slopes, fed by snowbanks lying several hundred feet higher, showed the usually common hepatics

<sup>1</sup>Ibid.



(*Arnellia fennica*, *Solenostoma polaris*, *Cephaloziella arctica*, *Scapania gymnostomophila*, *Lophozia quadriloba*), although the higher slopes, largely of loose scree, where less calcareous conditions obtained, bore small patches of the rarer and more localized species found again only in the Mt. Pullen area. Among them were the liverworts *Eremonotus minutus*, *Tritomaria quinquedentata* and its var. *grandiretis*, *T. heterophylla*, *Lophozia excisa* and *latifolia*, *L. alpestris* var. *major*, *Scapania polaris*, *Anthelia juratzkana*, *Gymnomitrium corallioides*, *Plagiochila arctica*, and the mosses *Orthotrichum killiasii*, *Polytrichum piliferum*, *P. alpinum*, *P. juniperinum*, *Hypnum cupressiforme*, *Encalypta rhabdocarpa*, *Isopterygium pulchellum*, *Grimmia apocarpa*, *Racomitrium canescens*, *R. lanuginosum*, etc. Since the flora of this ridge proved to be similar to that found on Mt. Pullen and The Dean, further exploration to the west was not deemed highly profitable. As the author at this point was at least 35 miles from his base and had exhausted his food supplies, he could not penetrate further into the mountains to the west. During this trip of roughly 75 miles, only four or five sites were passed at which more than one or two species of Hepaticae could be located; the more tolerant mosses, and even more tolerant and ubiquitous lichens, were, however, much more fully represented. Indeed, over much of the drier terrain, particularly dry plateaus or gentle slopes, lichens, *Saxifraga oppositifolia*, and more rarely *Salix arctica* were almost the only plants, accompanied in crevices occasionally by a few mosses (among them: *Ditrichum flexicaule*, *Barbula icmadophila*, *Pohlia cruda*, *Holmgrenia chrysea*, *Distichium capillaceum*). On dry, loose scree slopes, at elevations of 1,200 feet or more, the vegetation was even more barren; several lichens (*Rhizocarpon* being the most common) and a few mosses (*Racomitrium lanuginosum*, *R. canescens*, *Grimmia apocarpa*, *Bartramia ithyphylla*, *Ditrichum flexicaule*, *Polytrichum alpinum*) were frequent, whereas on local soil accumulations between scree fragments *Gymnomitrium concinnatum* or *G. corallioides* occurred rather rarely. Only on steep slopes with overhanging snowbanks and along the margins of the snow-fed, swift-running streams was any extensive development of vegetation noted. On such slopes, and on the edges of the shallow rivulets or streams draining them, the vegetation proved to be largely calciphilous, a relatively few common species (*Arnellia fennica*, *Cephaloziella arctica*, *Blepharostoma trichophyllum* ssp. *brevirete*, among the Hepaticae; *Tomenthypnum nitens*, *Holmgrenia chrysea*, *Philonotis tomentella*, *Encalypta alpina*, *Hypnum callichroum*, *H. bambergeri*, *H. revolutum*, *Barbula icmadophila*, etc., among the Musci) recurring.

Equally impressive was the fact that, although most of the entire area consisted of stony and rocky ground, vertical cliff-faces and rock-crevices were nonexistent. The very few sites found where bed-rock was exposed and *in situ* proved to bear few, but very interesting species. For instance, the only collections of *Cephaloziella grimsulana*, *Scapania lapponica*, *Marsupella ustulata*, and the mosses *Mielichhoferia mielichhoferiana*, *Grimmia alpestris*, and *Hygrohypnum alpestre* came from damp rock-crevices along two small ravines at the south end of Hilgard Bay. Similar sites were sought for in vain. The absence of exposed, nonweathered bed-rock is due to several factors, chief among them are violent weathering, the accumulation in the ravines and on almost all sheltered slopes of large masses of snow and firn-ice that do not disappear at all or only for a few weeks in late



July or early August, and "snow-melt" in mid-June, during which period the ravines become raging torrents, with the result that loose and weathered rocks are rapidly moved, and vegetation, except on upper slopes, is largely destroyed. Therefore, the habitats in which much of the more profitable collecting is usually done elsewhere do not exist in the general area.

Most impressive was the extremely restricted development of the bryophyte vegetation. The Arctic is often considered as an area where mosses and lichens abound and where the bryophyte cover exceeds by far that of the vascular plants. This concept is largely erroneous. Locally, the largest amount of cover consisted of angiosperms. On broad, low-lying plateaus or gentle, dry-to-moist slopes, *Saxifraga oppositifolia*, *Papaver radicum*, *Cerastium alpinum*, *Salix arctica*, and more locally *Draba bellii* and *alpina*, *Oxyria digyna*, *Taraxacum phymatocarpum*, *Dryas integrifolia*, and a few grasses often comprise the bulk of the vegetation. Bryophytes are rare and consist almost exclusively of a few tolerant mosses (*Holmgrenia chrysea*, *Ditrichum flexicaule*, *Pohlia cruda*, *Timmia austriaca*, *Tortula ruralis* and *Barbula icmadophila*, occasionally *Myurella tenerrima*, *Encalypta alpina*, and *E. procera*). Only where overhanging, permanent (or at least long-persisting) snowbanks irrigate lower slopes does extensive bryophyte cover occur. Similarly, on the margins of streams or wet polygon fields fed by snowbanks or on poorly-drained polygon fields (particularly around intermittent or permanent pools), a number of calciphilous mosses (often *Drepanocladus*) and a few liverworts occur.

The remaining three weeks of the season served to confirm the general impressions given above. On August 13, the well-vegetated slopes along the seashore were investigated. Although a varying distance of 5 to 50 feet along shore consisted of partly open water, the ice cover beyond this was virtually complete, except for small leads. Large ice-floes up to 30 to 50 feet high were stranded and usually frozen fast near the shore; the small areas of open water were partly covered with new ice. Investigation was confined to the area from the foot of Cape Belknap westward for about one mile. The gentle moss-covered slopes, within a hundred feet of shore, were largely late-snow areas and were relatively damp. The highly calcareous clay-shale slopes were covered with a restricted number of mosses (*Campylium stellatum*, *Tomenthypnum nitens*, *Anoetangium tenuinerve*, *Timmia austriaca*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Philonotis fontana*, *Amblystegiella sprucei*, *Isopterygium pulchellum*, *Barbula icmadophila*, *Fissidens arcticus*, *Cinclidium arcticum*, *Encalypta alpina*, etc.), and a few Hepaticae (*Arnellia fennica*, *Cephaloziella arctica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Solenostoma polaris*; also the less common *Lophozia quadriloba*, *L. heterocolpa* var. *harpanthoides*, *L. pellucida*, chiefly the small-celled var. *minor*, as well as the locally very rare *Plagiochila asplenioides*; in wetter sites also *Trichostylium pinguis*). These slopes were also covered with scattered clumps of *Saxifraga oppositifolia*, *S. caespitosa*, *S. flagellaris*, and *Cerastium alpinum*, less often *Papaver radicum* and *Oxyria digyna*. On open, damp, calcareous clay polygon soil *Athalamia hyalina* was common, although extremely scattered in occurrence, together with *Juncus biglumis*, and various grasses including *Phippisia algida* and *Alopecurus alpinus*.

On August 14, the irregular hills southwest of Mt. Pullen were explored, and on the way, the damp, steep slopes at the head of Parr Inlet were examined. At the last site *Sauteria alpina* and *Lophozia gillmani* were



collected on the damp, broken polygon soil at the edges of intermittent drainage slopes; associated were *Stellaria monantha*, *Juncus biglumis*, *Eriophorum angustifolium* var. *triste*, besides *Alopecurus alpinus* and other grasses, as well as *Saxifraga caespitosa*. The hills southwest of Mt. Pullen were largely permanently snow-covered, except on exposed slopes, with much permanent firn-ice in the small valleys; only a very limited amount of collecting, therefore, could be done.

However, the insolated, relatively warm southwest-facing, lower slopes of Mt. Pullen, previously uninvestigated, provided some interesting additions, chiefly a few mosses freely fruiting (*Polytrichum alpinum*, *Timmia austriaca*, *Pohlia nutans*, *Tortula ruralis*, *Barbula icmadophila*, *Ceratodon purpureus*, *Ditrichum flexicaule*, etc.). "Fruit" on all but rather weedy mosses is in most cases rarely developed. This is also true of the Hepaticae, excepting the very common *Cephaloziella arctica* and the parœcious *Lophozia excisa* and *Solenostoma polaris*. Hepaticae on such insolated, relatively warm slopes were rare (*Scapania polaris*, *Solenostoma polaris*, *Lophozia alpestris* var. *major*, *Scapania gymnostomophila*, *Cephaloziella arctica*, etc.). On the west-southwest slopes of Mt. Pullen, however, many of the rarer species found also on the slopes of The Dean and on the northeast slopes of Mt. Pullen were again noted, among them: *Tritomaria heterophylla*, *Anthelia juratzkana*, *Lophozia heterocolpa*, and its var. *harpanthoides*. On steep, snow-covered upper scree slopes of Mt. Pullen a restricted moss-lichen flora was found (including the mosses *Rhacomitrium lanuginosum*, *R. canescens*, *R. sudeticum*, *Arctoa anderssonii*, *Grimmia alpicola* var. *latifolia*, *G. tenuicaulis*, *G. torquata*, *G. apocarpa*, *Orthotrichum killiasii*, *Dicranoweisia crispula*, *Polytrichum alpinum*, most of which are exposure-tolerating and not obligate calciphiles); this was typical also of the upper slopes of The Dean and of similar slopes toward the United States Range. Near the summit, many of the same species recurred, as well as *Gymnomitrium concinnatum* and *G. corallioides* (at 1,550 to 1,600 feet). Although Hepaticae were very infrequent in such noncalcareous, exposed sites, except for the *Gymnomitria*, a series of interesting mosses (*Arctoa*, *Grimmia* sp., *Rhacomitrium* sp.) were confined to them.

The bryophyte collections, without doubt, give a good picture of the extent of the bryophyte flora; this is not the case with the lichen collections. The latter group was not so intensively collected; local transportation being by foot only, it became physically impossible to carry many saxicolous lichens together with necessary collecting and camping gear. Also, the largest amount of lichen material collected, indeed almost all the more interesting terricolous and saxicolous material, had to be abandoned during the night of July 21-22, when the author had become totally lost in dense fog for 23 hours, without food or sleeping gear; since it was imperative to keep moving constantly in order to avoid freezing, the pack carried had to be lightened. Thus it is possible that the lichen flora of this area may actually include twice the number of species reported.

The completeness of the bryophyte collections, particularly of the Hepaticae, is evident from the fact that 38 taxa were collected within 12 to 15 miles of the station during the initial months' collecting, though subsequent collecting from July 21 to August 21, including field work to a distance of 35 miles, added merely seven additional taxa! From August 7 to 21, field work added only a single species!



The collections made in the Alert region are deposited as follows: (1) A complete set in the National Museum of Canada; (2) A complete set of the lichens in the herbarium of J. W. Thomson, Madison, Wisconsin; (3) A complete set of the Hepaticae in the herbarium of R.M. Schuster, Amherst, Mass.; (4) Nearly complete sets of the mosses in the herbaria of R.M. Schuster and in the New York Botanical Garden; (5) Less complete sets of the mosses and Hepaticae in the herbaria of Duke University, the Riksmuseum, Stockholm, Sweden, the Hattori Botanical Laboratory, Obi, Nichinanshi, Japan. An incomplete set of the Hepaticae in the herbarium of H. Buch, Helsingfors, Finland.

#### LOCATION OF COLLECTING STATIONS

In order to save space, dates of collection and latitude and longitude are not given in the citations of specimens, nor, in some instances, are adequate descriptions of the locality. These are briefly given below; latitude and longitude are given for only the first citation of a locality visited. The latitude is, in all instances, reasonably accurate (within one minute or less, usually), but the longitude of the interior areas visited may be in error by 5 to 10 minutes. It should be noted that there are discrepancies of more than this between the recent Canadian charts (still classified) and the U.S. Aeronautical Chart of 1950 of the northern coast of Ellesmere Island.<sup>1</sup> There is no accurate chart of northern Ellesmere Island, except for the immediate coastal area; the elevations cited for the interior in the U.S. "World Aeronautical Chart" of 1950 for the area immediately south and southwest of Alert appear to be in error by at least 800 to 1,000 feet, the elevation being usually overestimated by that extent. For this reason, elevations given for the region from Hilgard Bay south and west are approximations based on visual readings, supplemented by correlation with the reasonably accurate Canadian charts of the coastal region; they must be interpreted as such, although they are surely more accurate than those of the charts cited above.

1. No. 35030-35070. June 3-9, 1955. Alert, N.W.T. Lat. 82° 30' N.; long. 62° 20' W. (all within one mile of Station). Wind-blown areas where snow cover is slight or nonexistent; dry, eroded, saxifrage barrens.
2. No. 35071-35100. June 13, 1955. Alert, N.W.T. (area to S. and SW. of Station, partly at shallow pools one mile SW. of Station). Clay-shale barrens with shallow pools.
3. No. 35101-35140. June 16, 1955. North slope of Mt. Pullen, 82°26'; 62°20'. Calcareous clay-shale-sandstone slope, exposed within 10 days after start of snow-melt. Local, moist, relatively rich moss-tundra.
4. No. 35141-35155. June 16, 1955. Head of Parr Inlet, Dumbbell Bay, *ca.* 82°29'; 62°20'. Snow-fed solifluction slope, rich moss-tundra.
5. No. 35156-35200. June 24, 1955. West and NW. slopes of The Dean, 82° 25 to 26'; 62° 05-15'. Rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks; calcareous.
6. No. 35201-35220. June 28, 1955. 2.5 miles W. of Cape Belknap, S. of Williams Island, 82°32'; 62°32'. Snow-fed slope, just E. of Colan Bay; calcareous solifluction slope, clayey and calcareous.
7. No. 35225-35260. June 29, 1955. Westernmost, steep, small ravine at S. end of Hilgard Bay (Camp Ravine), 12 to 15 miles SW. of Alert, 82°26'; 63°25'. Calcareous clay-shale slope.

<sup>1</sup>For the description and approximate elevation of some of the interior areas, see the Introduction.



8. No. 35261-35265. July 15, 1955. One mile W. of Alert.
9. No. 35266-35280. July 15, 1955. 2.5 miles W. of Cape Belknap, 82°32'; 62°32'.
10. No. 35281-35299. July 17, 1955. Cape Belknap, 82°32'; 62°20'. Clay-shale damp moss-tundra; calcareous.
11. No. 35300-35360. July 21, 1955. Mt. Pullen and vicinity, 82°26'; 62°15'. All on east slope of mountain; on rocky, steeply sloping, weakly or hardly calcareous scree-slopes.
12. No. 35361-35379. July 21, 1955. Low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen; calcareous; permafrost 2 to 4 inches below surface.
13. No. 35380-35390. July 21, 1955. Stony outwash plain half a mile N. of Mt. Pullen, calcareous shallow slope, draining into Ravine Bay.
14. No. 35391-35470. July 27, 1955. The Dean. No. 35391-35399 near summit, from dry scree slopes, not or hardly calcareous; No. 35400-35470, W. slope near base, moist, more or less calcareous moss-tundra and rocky clay slopes.
15. No. 35475-35510. Aug. 5, 1955. Hilgard Bay, 82°27'; 63°10'. Mouth of deep ravine on S. side, rotting rock-outcrop, not strongly calcareous, in shade.
16. No. 35511-35512. Aug. 5, 1955. Cliff face at S. end of Hilgard Bay, 82°27'; 63°08'. Firm, moss-covered, more or less calcareous, stabilized scree slope.
17. No. 35520, 35527-35550. Aug. 6, 1955. Valley between Peak 1 and Peak 2, 82°22'; 64°15'. Rocky, clayey moss-tundra, on more or less stable slopes.
18. No. 35523-35526. Aug. 6, 1955. W. slope of Peak 1, 82°23'; 64°05-15'. Dry rock field and saxifrage barrens. No. 35521 on submersed rock, W. fork Hilgard Creek, W. of Peak 1.
19. No. 35551-35555. Aug. 6, 1955. Scree slope 4 to 5 miles W. of Peak 1, 82°24'; 64°30'. Dry noncalcareous, unincorporated scree.
20. No. 35556-35620. Aug. 6, 1955. 9 to 10 miles W. of Peak 1, 82°24'; 65°20-30'. Scree slope (noncalcareous above, basic below). Farthest west attained, toward U.S. Range, *ca.* 2,000-3,000 feet.
21. No. 35625-35680 and 35750-35760. Aug. 13, 1955. Cape Belknap, *ca.* 1 to 2 miles W. of tip edge of Lincoln Sea, 82°32'; 62°20'. Moist clay slopes.
22. No. 35681-35700; 35731-35800. Aug. 14, 1955.
  - (a) 35681-35700, Parr Inlet. Moist clay, calcareous solifluction slopes.
  - (b) 35731-35745, scree slope, hill SW. of Mt. Pullen, 82°25'; 62°25'.
  - (c) 35746-35800, SW. slopes of Mt. Pullen and near summit, 82°25'; 62°20'. More or less loose scree.
23. No. 35711-35730. Aug. 5, 1955. Hilgard Bay.
24. No. 35700-35710. Aug. 6, 1955. Slope, 3 to 4 miles W. of Peak 1. Angiosperms.
25. No. 35801-35830. Aug. 18, 1955. 1.5 to 2.5 miles W. of Cape Belknap, 82°32'; 62°20'. Moist, gravelly and clayey slope at edge of Arctic Ocean.
26. No. 35840-35900. Aug. 22, 1955.
  - (a) 35840-35860, just W. of Alert. Dry, saxifrage barrens.
  - (b) 35861-35880, ponds between Parr Inlet and Upper Dumbbell Lake. Clayey, calcareous low areas.
  - (c) 35881-35900, Upper Dumbbell Lake, *ca.* 125 feet. Moist, calcareous clay.
27. No. 35901-35940. Aug. 25, 1955.
  - (a) 35901-35915, deep ravine, S. side of Hilgard Bay, 82°26'; 63°18'. Noncalcareous, rotting schist and slate ledges.
  - (b) 35916-35935, "Camp Ravine," Hilgard Bay, 82°26'; 63°25'.
  - (c) 35936, Lake Anxiety, 62°50'; 82°27'. Moist, calcareous, low flats.
  - (d) 35937, Parr Inlet. Moist, calcareous, low flats.
  - (e) 35938-35940, plateau near Parr Inlet.
28. No. 35941-35945. Aug. 24, 1955. Point, W. side of Ravine Bay, 82°31'; 62°15'. Dry saxifrage barrens.



## HEPATICAE

RUDOLF M. SCHUSTER

Before presenting the catalogue of species that follows, certain general observations may be of value. First, the extraordinary dearth of Hepaticae should be mentioned. This, in part, explains why only some three species, out of the 43 here listed, had been previously reported from the northernmost parts of Ellesmere Island. When this paucity of previous reports is contrasted with the frequency with which the species of Musci collected had been found in the same general area by previous students, a great difference is at once apparent. To a large extent this is due to the fact that the Hepaticae occur, in almost all cases, as small admixtures<sup>1</sup> amidst mosses, or as minute patches—or individual plants—which only the experienced collector could detect. (To restudy the material here reported on, therefore, may require in some cases prolonged search in the proper packet; in most cases the individual plants on which my identification is based have been placed in small packets within the larger herbarium packet.) Secondly, the approximate 1:2.5 ratio of taxa of Hepaticae and Musci found suggests that at least a number of species of mosses have been missed, or, alternatively, that some of the moss species embrace two or more definable elements. Thirdly, the extraordinary restriction of the majority of species should be emphasized. It has already been noted that plant cover in this arctic desert region is incredibly sparse. Superimposed on this is the exceedingly localized distribution of hepatics within the few relatively well-vegetated slopes found. As a consequence, all but a handful of species were collected at only two or three localities, even though some hundreds of linear miles were covered in the field work. Only a notable group of high arctic ubiquists—almost weedy in nature—were found repeatedly. Among these are *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, and to a lesser extent, *Scapania gymnostomophila* and *Lophozia alpestris* var. *major*. Of these species only the *Arnellia* ever occurred in patches that were nearly pure.

Finally, some comment regarding the new taxa treated herein may be pertinent. The several new species in the genus *Lophozia* (*L. pellucida*, *L. hyperarctica*), and the several new varieties in that genus (*L. floerkei* var. *hyperborea*, *L. kunzeana* var. *rotundiloba*) suggest that our knowledge of this critical group is far from perfect. Because of the technical nature of these taxa, detailed observations of them have been published in part in another connection. In several instances plants have been assigned to species from which it may eventually prove necessary to divorce them. For example, *Scapania lapponica*, reported herein for the first time from the New World, may possibly prove to represent a closely allied, but new species. In such doubtful instances, I have preferred to maintain a conservative species concept. On the other hand, I have felt compelled to describe as new

<sup>1</sup>In the case of the hepatics, every effort has been made to segregate the component parts of admixtures into individual packets. For example, there are packets 35313 (mostly mosses), 35313a, 35313b (*Tritomaria quinque-dentata* and *Eremonotus minutus*, respectively). For segregate packets, letters are used.



*Scapania polaris*, a species of the Sectio Curtae, which is already burdened with a plethora of "technical" species. Yet this plant cannot be satisfactorily placed within either *S. mucronata* or *S. calcicola*, to both of which it bears certain similarities.

It may seem remarkable that so many novelties have turned up in the Hepaticae. It should, however, be kept in mind that the species of this group are, in most instances, present as traces. No trained hepaticologist has ever collected in the high Arctic; hence the discovery of endemic high arctic taxa should be no cause for surprise. It is to be anticipated that other novelties from the Arctic, particularly from areas that have escaped glaciation, will be found.

I should like to acknowledge the valued advice given by Dr. S. Arnell (Gävle, Sweden) and Dr. H. Persson (Stockholm, Sweden) with regard to several intractable species problems, particularly with reference to *Scapania polaris* and *lapponica*.

#### PTILIDIACEAE<sup>1</sup>

##### 1. *Ptilidium ciliare* (L.) Hampe

Mt. Pullen, in scattered flocculent patches, in rather rich moss-tundra on NE. base of mountain (35318, 35318a).

Although reported from several localities in central and southern Ellesmere Island by Bryhn (1906), this marks the northernmost station for the species, as well as for genus and family. In Greenland it is known northward at least to Dove Bugt (76° 40'N.) on the northeast coast. The plant was very rare in the Alert area, being found only once, and in rather small quantity, in swelling tufts, on humus, over weathered basic rocks, on a slope "fed" by permanent snowbanks. Associated were *Tritomaria quinquedentata* and the mosses *Grimmia apocarpa*, *Racomitrium lanuginosum*, *R. canescens*, *Drepanocladus uncinatus*, *Dicranum fuscescens*, *Hylocomium splendens*, and *Polytrichum alpinum*. The Alert material is unusual in that the leaf-margins and cilia are strongly decolorate, a feature I have not seen elsewhere in the species.

#### BLEPHAROSTOMACEAE

##### 2. *Blepharostoma trichophyllum* subsp. *brevirete* (Bryhn & Kaalaas) comb. n.

*Blepharostoma trichophyllum* var. *brevirete* Bryhn & Kaalaas, Rept. 2nd Norwegian Arctic Exped. in the "Fram" 1898-1902, 11: 46, 1906.

Among mosses, on damp, snow-fed tundra bank, over calcareous shale and clay slopes, between Dumbbell Bay and The Dean (35054). Damp, calcareous clay slope, soon snow-free, Alert (35051b). Moist, calcareous, polygon soil, edge of temporary pond, between Alert Weather Station and Dumbbell Lake (35063). Moist depression in otherwise dry *Saxifraga oppositifolia* slope, over clay and shale, and damp, calcareous, clay-shale shingle slope, in *Saxifraga oppositifolia* - *Salix arctica*-moss "heath," Dumbbell Bay, near Alert (35080a, 35080b, 35084). Over damp, sub-basic humus, clay-shale, weathered slope, below snowbank, foot of Mt.

<sup>1</sup>The classification into suborders and families is as in Schuster (1958c).



Pullen (35109, 35135). Damp, moss-covered talus slope, below snow-bank, N. face of Mt. Pullen, *ca.* 450 to 500 feet (35103d). Damp, calcareous solifluction slope, clay-shale, head of Parr Inlet (35144, 35145, 35145a, 35151). Damp, basic humus, slope of The Dean (35185). Moist, calcareous, clay-shale solifluction slope, below persisting snowfield, 2.5 miles W. of Cape Belknap, on edge of polar ice-cap, S. of Williams Island; mouth of Black Cliffs Bay opposite Cape Woolen (35209, 35210c, 35212). Damp, basic, clay-shale sandstone slope, much weathered, below persisting snowbank, S. end of Hilgard Bay (35231, 35231b, 35225a). Damp, thin humus over calcareous, snow-fed slope, S. end of Hilgard Bay (35240, 35250a). Moist, calcareous clay slopes, near shore of Dumbbell Bay, Cape Belknap (35291, 35292, 35295, 35296, 35296a, 35296b, 35296c). Damp, peaty soil over basic, weathered snow-fed slopes, Mt. Pullen (35307d, 35313c, 35313d, 35344, 35345). Damp, peaty soil, snow-fed slope, highly calcareous, E. face of Mt. Pullen (35337). Moist, basic, humus-covered, snow-fed slope of The Dean (35409, 35409a). In yellow-green patches, damp, calcareous, steep clay-shale slope, valley between Peak 1 and Peak 2, *ca.* 5 miles SW. of end of Hilgard Bay, *ca.* 800 to 950 feet (35547, 35549, 35549a). Yellow-green patches over clay-shale slope, at edge of polar pack-ice, N. side of Cape Belknap, *ca.* 1.5 to 2 miles from tip (35631). Damp, calcareous, moss-covered, clay-shale slope, edge of frozen Lincoln Sea, edge of polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35636, 35750a, 35817a). Over calcareous, weathered scree, on thin humus, W. end of Mt. Pullen, *ca.* 850 feet (35723). Exposed humus, over moist, snow-fed, calcareous clay-shale slope, SW. end of Mt. Pullen, *ca.* 900 to 1,000 feet (35792e). Moist humus over calcareous, steep, clay-shale slope, S. end of Hilgard Bay (35927, 35932a, 35932b).

Typical *B. trichophyllum* apparently does not occur so far north as northern Ellesmere Island, all of the abundant local material being referable to the northern subspecies. Arnell (1951) has recently devoted a study to this plant, showing it differs by a series of characters from "normal" *B. trichophyllum*; it would appear that a good geographical race, or perhaps even a sibling species, is involved. The plant is one of the few rather ubiquitous hepatics at such very high latitudes, occurring under a wide variety of conditions, usually mixed with various mosses. It is one of the few hepatics that occur in areas only slightly covered by snow and exposed early in the season. It could be found as early as June 3 to 8, in damp crevices on a clay-shale slope, along a stream, in sites where snow cover was very slight, in association with *Hypnum revolutum*, *Tortula ruralis*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Barbula icmadophila*, *Timmia austriaca*, *Mnium hymenophyllum*, *Anoetangium tenuinerve*, *Philonotis fontana*, *Bryum inclinatum*, *Timmia norvegica*, *Encalypta alpina*, and *Holmgrenia stricta*; the associated hepatics were *Arnellia fennica*, *Solenostoma polaris*, and *Scapania gymnostomophila*. The species is almost weedy locally, except on dry, exposed, noncalcareous scree-slopes (where it is rare or lacking); it therefore occurs with a very large variety of associated hepatics and mosses. Hepaticae most frequently associated with it were *Arnellia fennica*, *Lophozia gillmani*, *L. pellucida*, *L. heterocolpa* and its var. *harpanthoides*, *L. muelleri*, *L. quadriloba*, *L. alpestris* var. *major*, *Scapania gymnostomophila*, *Trichostylium pinguis*, *Solenostoma*



*polaris*, *Cephaloziella arctica*. Less often associated were *Anthelia juratzkana*, *Cryptocolea imbricata*, *Tritomaria heterophylla*, *T. quinquedentata*, *Lophozia hyperarctica*, *Preissia quadrata*, *Athalamia hyalina*, rarely *Moerkia flotowiana*. This species sometimes occurs in large enough patches to form the matrix in which various tracheophytes may undergo ecesis (among them *Equisetum variegatum*, *Saxifraga oppositifolia*, and *Cerastium regellii*).

*Blepharostoma* appears to be uniformly sterile in the Alert area, no trace of sex organs, perianths, or gemmae being evident; its wide dispersal under such conditions is somewhat puzzling.

Although previously reported from central and southern Ellesmere Island, the variety is new to northern Ellesmere Island. However, the early report of *Blepharozia trichophylla* in Mitten (1878), from Parry's Sound, to the southeast of the area here treated, most probably refers to this subspecies. The subspecies was also reported from the Hudson Bay area by Schuster (1951) and from Alberta by Frye & Clark (1937-1947); the last report needs verification, the illustrations based on the report being in part misleading (for example, Fig. 1, reputedly a leaf, most probably represents a perichaetial bract). Apparently the subspecies is frequent in northernmost Scandinavia, according to Arnell (1951). Müller (1951-1958, p. 593) incorrectly describes the plant as occurring in "schwärzlichen Rasen"; the plant is actually a light yellow-green, much as are sun forms of typical *B. trichophyllum*. The present reports appear to be the northernmost for species, genus, and family.

## LOPHOZIACEAE

The Lophoziaceae are the best represented of the families of Hepaticae in the Alert area. The group is technical, and the local species poorly known. The following discussions are therefore extensive; in particular, study of the oil-bodies and stem anatomy has made possible a critical analysis of some of the taxa.

### LOPHOZIA Dumort.

#### Subgenus ORTHOCAULIS (Buch) Schuster

#### 3. *Lophozia quadriloba* (Lindb.) Evans

In bluish-black patches, on scattered, damp, moss-Saxifraga heath, snow-fed talus slope at foot of Mt. Pullen (35101a, 35102b, 35103f). Over thin humus on basic, weathered clay-shale slope, below persisting snowfield, foot of Mt. Pullen (35108a, 35122b, 35132, 35133b, 35113, 35118a). Moist, moss-heath, over weakly basic rocks, below persistent snowbank on NW. side of The Dean (35177, 35188, 35191a). Among *Drepanocladus* and other mosses on basic solifluction slope, shallow gorge below snowbank, NW. side of the Dean (35167a). Damp, calcareous slopes, below snowbank, S. end of Hilgard Bay (35231c, 35234b, 35235, 35238a, 35239). Damp, humus-covered, weakly basic, steep, weathered slope, S. end of Hilgard Bay (35250, 35250b, 35256). Damp, thin, peaty soil over calcareous, weathered slope, Mt. Pullen (35310, 35316, 35317). Moist, calcareous slope, spongy patches over wet, snow-fed humus on basic, strongly weathered slopes of



Mt. Pullen (35332, 35351a). Moist clay-shale outwash plain NE. of Mt. Pullen (35383a). Damp humus on calcareous clay-shale, low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen (35376a). Damp humus, snow-fed, weakly basic slopes of The Dean (35407a). Damp, calcareous, weathered, steep, snow-fed slope, valley between Peak 1 and Peak 2, ca. 850 to 900 feet, ca. 5 miles SW. of end of Hilgard Bay (35520a, 35548a). In brownish, dull, erect patches, over humus, weakly calcareous snow-fed scree slope, 2,000 to 2,400 feet, E. edge of U.S. Range, 9 to 10 miles due W. of Peak 1 (35598, 35600). Among mosses, damp, clay-shale calcareous slope, edge of polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35635 [=35638c], 35638d, 35634b, 35634a, 35752). Steep, loosely soil-covered, calcareous, snow-fed scree slope, hills SW. of Mt. Pullen, 6 to 7 miles S. of Alert (35733a). Blackish patches over thin humus, moist, snow-fed, calcareous, clay-shale slope, SW. side of Mt. Pullen (35762a, 35762b, 35792c, 35792d, 35795). In bluish-black patches on damp, calcareous humus over scree slope, W. end of Mt. Pullen, ca. 850 feet (35722). Damp, calcareous moss-tundra, over moist clay slope above frozen Lincoln Sea, 2 miles W. of Cape Belknap (35824a).

*L. quadriloba* is the only species of the subgenus *Orthocaulis* frequently found at latitudes as high as those of northern Ellesmere Island; it occurs slightly farther northward in northernmost Greenland and, judging from its frequency, will be found in calcareous and subcalcareous areas throughout the northernmost portions of the globe, wherever locally snow-free areas are found.

The species is very variable locally; I do not believe that the so-called variety *heterophylla* of Bryhn and Kaalaas, described from central and southern Ellesmere Island, is other than a reduced and persistently juvenile phase, common under "difficult" conditions, such as are normal in the high Arctic. Much of the local material has predominantly 2- and 3-lobed leaves, hence would be referable to this variety, including collections 35824a, 35118a, 35130, and others. The species occurs wherever there is rather dense moss-tundra, over calcareous or subcalcareous, soil-covered rocks. It is most commonly found on slopes that are irrigated by snow-melt. The more frequently associated hepatics are *Arnellia fennica*, *Scapania gymnostomophila*, *S. polaris*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, *Cryptocolea imbricata*, *Solenostoma polaris*, *Trichostylium pinguis*, *Lophozia heterocolpa* and var. *harpanthoides*, *L. pellucida*, *Tritomaria quinquedentata*, *T. heterophylla*, less often *Anthelia juratzkana*, *Plagiochila arctica*, *Lophozia alpestris* var. *major*, *L. floerkei* var. *hyperborea*, *L. gillmani*, and *L. badensis*. Among commonly associated mosses are *Ditrichum flexicaule*, *Holmgrenia chrysea*, *Philonotis fontana*, *Timmia austriaca*, *Myurella julacea*, *Barbula icmadophila*, *Encalypta alpina*, *Distichium capillaceum*, *Polytrichum alpinum*, *Didymodon recurvirostris*, *Hypnum revolutum*, *Pohlia cruda*, *Tortula ruralis*, *Drepanocladus uncinatus*, *Philonotis fontana*, less often *Fissidens arcticus*, *Hypnum cupressiforme*, *Bryum capillare*, *Isopterygium pulchellum*, *Mnium hymenophyllum*, *Myurella tenerrima*, *Dicranoweisia crispula*, and *Rhacomitrium canescens*.

The various manifestations of the species are usually recognizable in the field by the bluish-black to blackish-green colour of the erect tufts which may have a rather "inky" cast.



#### 4. *Lophozia floerkei* (Web. & Mohr) Schiffn.

Typical *L. floerkei* was not found in the Alert area. However, a plant which departs considerably from this was collected several times. It differs from the species proper in the coarsely verrucose cuticle, the 2- to 3- to 4-lobed leaves, rather than nearly uniformly trilobate leaves, the broader leaf-shape, and the larger leaf-cells. In several respects it resembles the Hudson Bay plant I referred (Schuster, 1951) to *L. floerkei* var. *densifolia* Nees, which was admittedly transitional in many respects to *L. quadriloba*.

The plants from the Alert area differ markedly from the material referred to var. *densifolia* in being less imbricate-leaved, the shoots being hardly julaceous, and in the larger leaf-cells. In the Alert material the cells average (18.5–21) 22 to 25  $\mu$  on the margins; in the Hudson Bay plant they range from 16 to 18  $\mu$  (Schuster, 1951). However, the leaf-shape, in particular the polymorphism in the leaves, and the form of the under-leaves suggest a close affinity with the Hudson Bay plant. I am particularly puzzled by the fact that the var. *densifolia* (or at least the Hudson Bay plants assigned to this) and the Alert material agree in the tendency to have a coarsely verrucose or papillose cuticle; they agree equally in the tendency for the leaf sinuses to extend down to the middle of the leaf. These characters very much suggest *L. quadriloba*; yet in the Alert area the two plants are obviously distinct, even in the field—the plants assigned to *L. floerkei* being much more nearly similar to *L. kunzeana* in facies, without the tendency to form inky, bluish-black or dark bluish-green, spongy mats or caespitose patches. The broad and blunt leaf-lobes are also very different from those of normal forms of *L. quadriloba*. A major distinction lies in the leaf-cells, which are very large in the Alert material assigned to *L. floerkei*, while they are relatively small in *L. quadriloba*. It may, perhaps, be necessary to unite the plants I referred (1951) to var. *densifolia* and the plants I here describe as var. *hyperborea*, into a single species, based on (a) the coarsely papillate cuticle; (b) the polymorphous, very broad, 2- to 3-, rarely 4-lobed leaves, with (c) a deep sinus, slightly reflexed at base, but without the margins of the lobes being reflexed; (d) uniform absence of gemmae; (e) the bifid, rather sporadically ciliate under-leaves; (f) the weak tendency to develop cilia or teeth of the postical—but never on the antical—leaf-margin; (g) the broadly triangular to ovate-triangular leaf-lobes. Of these characters, a, b, c, and d suggest *L. quadriloba*, except that the leaves are too broad; d, e, f, and g suggest, more nearly, *L. floerkei*. Until much more material is collected, the disposition of these plants must remain in doubt; if the constancy of characters cited here can be demonstrated, it will be necessary to elevate the var. *hyperborea* to the rank of species. For the time being, the following key will separate the taxa, all belonging to the Sectio Kunzeanae (Schuster, 1951a), occurring in the Alert area:

#### KEY TO THE SECTIO KUNZEANAE

1. Leaves with broadly triangular to ovate lobes, usually as wide or wider than long, blunt to rounded at the tips; leaf-sinuses descending 0.35–0.5 the leaf-length; antical leaf-margins never with cilia or teeth; plants green to brownish, never bluish-black or blackish; leaf-sinuses slightly reflexed to gibbose, but never the lobe-margins, the lobes not channelled.....



2. Leaves predominantly 2-lobed, very exceptionally 3-lobed, divided to the middle; postical leaf-base usually edentate, rarely with stalked slime papilla; underleaves lanceolate to bifid, usually eciliate; marginal cells of lobes 17–20  $\mu$ ; median cells *ca.* 20–25 (26)  $\times$  22–26 (28)  $\mu$ ; cuticle rather closely but not coarsely verrucose to verrucose-striate; oil-bodies 2–5 (6) per cell; trigones coarse and bulging. . . . . 3
3. Leaf-lobes blunt to obtusely pointed, never decolorate. *L. kunzeana*
3. Leaf-lobes, with isolated exceptions, broadly, evenly rounded, usually decolorate; plant very dense-leaved. *L. kunzeana* var. *rotundiloba*
2. Leaves variable, varying from 2–3 to 3–4-lobed, divided for 0.35–0.45 (0.5) their length, the lobes blunt or bluntly pointed, ovate-triangular; postical leaf-base usually with (0) 1–2 (3) teeth or cilia; underleaves bifid, the lanceolate lobes more or less ciliate; marginal cells of lobes (18.5–21) 22–25  $\mu$ ; median cells *ca.* 23–26 (28)  $\times$  26–32  $\mu$ ; cuticle, at least locally, with very coarse, elliptical papillae; oil-bodies (4–6) 7–15 per cell; trigones small. *L. floerkei* var. *hyperborea*<sup>1</sup>
1. Leaves with narrowly triangular lobes, usually longer than broad, subacute to bluntly pointed at apex, often with reflexed margins and strongly gibbose sinuses; leaf-sinuses descending (0.45) 0.5–0.65 the leaf-length; antical leaf-margin, at least of larger leaves, usually armed at base; plants usually somewhat deep, bluish to bluish-black green; leaves at least locally (3) 4-lobed. Cells without coarse trigones, small: marginal 12–14 (15)  $\mu$ , those of middle of lobes 13–15 (18.5)  $\times$  14–18.5 (21)  $\mu$ ; median cells 17–19 (23)  $\times$  18–25 (29)  $\mu$ ; oil-bodies 4–6 (7–11) per cell; trigones not bulging. *L. quadriloba*

#### 4a. *Lophozia floerkei* var. *hyperborea* var. n.<sup>2</sup>

Plants erect to loosely procumbent, somewhat julaceous, brown to brownish-black, with leaves 2- to 3-, less often 4-lobed, without marginal teeth or cilia dorsally, and often with 0 to 1 marginal teeth postically, the sinuses sharp, only slightly reflexed. Leaves unusually broad, even when 2- to 3-lobed, the bilobed leaves varying from 1.1 to 1.3 times as wide as long, the trilobed leaves usually 1.3 to 1.5 times as wide as long, the sinuses descending 0.35 to 0.5 the leaf-length, slightly reflexed at base (but the lobes with sinuses not reflexed, the lobes never channelled); lobes broadly triangular, usually wider than long, or broadly ovate-triangular, blunt to subacute at apex, usually strongly incurved or erect, the leaves thus quite concave. Underleaves large, bifid, the margins usually with several, often rather abbreviated cilia. Plants with much the aspect of those of *Lophozia atlantica*, and similarly large-celled, with brownish, often subquadrate cells, bearing only small trigones. Marginal cells of lobes (18.5–21) 22.5 to 25  $\mu$ , locally to 27  $\mu$ ; median cells of free lobes variable, but averaging 20 to 25 (26)  $\times$  20 to 27  $\mu$ , up to 22 to 25 (27)  $\times$  22 to 26 (28)  $\mu$ ; cells of middle of the undivided part of leaf (24) 25 to 29  $\times$  (25) 26 to 30 (32)  $\mu$ ; cuticle coarsely verrucose, the papillae up to 4 to 5  $\times$  8 to 10 or to 6  $\times$  12  $\mu$ ; oil-bodies (4 to 6) 7 to 15 per median cell. Gemmae consistently lacking.

TYPE. Damp, weakly basic slope, snow-fed, on calcareous clay-shale substrate, below persistent snowbank, foot of Mt. Pullen (35101). Cotypes: Same locality data (35121, 35132). Brownish, scattered plants on humus,

<sup>1</sup>The Hudson Bay plant, referred (Schuster, 1951) to *L. floerkei* var. *densifolia*, would key here, but differs in (a) smaller leaf cells; (b) the thin-walled cells with coarse trigones; (c) the stouter, more julaceous shoots.

<sup>2</sup>Folia heterogena latissima, generaliter 2–3–4-lobata usque ad 0.35–0.45(0.5) longitudinem foliorum lobae latissime obtusae; cellulae valde verrucosae, magnissimae, marginibus generaliter 20–25 $\mu$ ; mediis 23–26 (28)  $\times$  26–32  $\mu$ . Typus: Mt. Pullen, Ellesmere I. (35101).



weathered slope of The Dean, at ca. 900 feet (35597). Moist, snow-fed scree slope, ca. 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1, Ellesmere Island (35572, 35576). Same locality data (35580). Moist humus, low scarp at edge of persistent snowfield, 0.25 mile N. of Mt. Pullen, Ellesmere Island (35366, 35366a, p.p.).

This variant occupies the same relationship to typical *L. floerkei* and *L. quadriloba* as does *Tritomaria quinquedentata* var. *grandiretis* to typical *T. quinquedentata*. It differs from *L. quadriloba* markedly in the large cells, in the tendency for suppression of the cilia of the leaf-bases (those of the antical base never appearing to be developed), and in the tendency for the development of 2 to 3 very broad, rather than 3 to 4 sharp, triangular leaf-lobes. In these features it suggests *L. atlantica*, from which it differs in the large underleaves, absence of gemmae, erect growth, fuscous coloration, etc.

Cell-sizes given above represent average measurements from a number of leaves of several collections. Comparative cell-sizes, from similar positions within the leaves, in typical *L. quadriloba* (35250b) follow: marginal cells of lobes 12 to 14 (15)  $\mu$ ; median cells within lobes, 13 to 15 (18.5)  $\mu$   $\times$  14–18.5 (21)  $\mu$ ; median cells of undivided portion of leaf 17 to 19 (23)  $\times$  18–25 (29)  $\mu$ . The latter measurements closely agree with those given by Müller (1951–1958, p. 626), who states the cells in *L. quadriloba* average 20  $\times$  25  $\mu$  in the leaf-middle.

The type material grew associated with *Tritomaria quinquedentata* and the var. *grandiretis*, *Eremonotus minutus*, *Scapania polaris*, *Lophozia quadriloba*, *L. excisa*, *L. alpestris major*, and *Cephaloziella arctica*. Associated mosses found juxtaposed (in 35571a and 35581) were *Hypnum bambergeri*, *H. revolutum*, *Encalypta procera*, *Tomenthypnum nitens*, *Myurella julacea*, *Barbula icmadophila*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Timmia austriaca*, *Anoetangium tenuinerve*, *Didymodon rufus*, *Tortula ruralis*, *Orthotrichum killiasii*, *Grimmia apocarpa*, *Racomitrium lanuginosum*, and *R. canescens*.

One cotype (35366, 35366a) consists of material scattered amidst *Lophozia kunzeana* var. *rotundiloba*, *Lophozia heterocolpa*, *Scapania polaris*, and *Eremonotus minutus*; the specimen consists chiefly of *L. kunzeana rotundiloba*, under which it is filed. Since the two species of the subgenus *Orthocaulis* occur together here, their separation, when admixed, becomes somewhat of a problem. The *L. floerkei* var. *hyperborea*, however, has largely 3-, locally 4-lobed leaves; the leaves are much broader than long, hardly decolorate at the acute apices; the cells are provided with only small trigones at the angles but have a perceptibly coarsely papillate cuticle; the postical leaf-bases are frequently armed with 1 to 2 obsolete teeth. By contrast, the rotund-quadrate leaves of the *L. kunzeana rotundiloba* are constantly bilobed, little wider than long; the broadly rounded apices of the leaves are often strongly decolorate; the cells have coarse trigones, but the cuticle is hardly perceptibly roughened; the postical leaf-bases bear, at most, a sessile slime papilla or one terminal on a 1-celled spur. More marked than these features are the differences in cell size, as illustrated in the following table:



TABLE I

|                               | <i>Lophozia floerkei</i> var. <i>hyperborea</i>                    | <i>Lophozia kunzeana</i> var. <i>rotundiloba</i>                          |
|-------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------------|
| Marginal cells of lobes.....  | 21-25 $\mu$ .....                                                  | 17-18.5 $\mu$                                                             |
| Median cells of lobes.....    | 21-23(25) X 22-28 $\mu$ .....                                      | (18) 20-22 X 21-25 $\mu$                                                  |
| Median cells below sinus..... | 23-26 (28) X 26-32 $\mu$ .....                                     | 20-25 (26) X 22-26 (28) $\mu$                                             |
| Cuticle.....                  | With very coarse papillae,<br>locally to 4-5 (6) X 5-7 (9) $\mu$ . | With, locally, more numerous,<br>smaller papillae, 2-3 X 2-4<br>(5) $\mu$ |

Otherwise the two taxa are rather similar; the leaves are concave, with somewhat erect lobes; the sinuses are weakly reflexed; the underleaves are lanceolate or bifid, with few or no cilia.

The occurrence, intimately admixed, of *L. floerkei hyperborea* and *L. quadriloba* in two collections (35101, 35132) is of significance. For some time I presumed that the plants of the var. *hyperborea* should be considered a large-celled variety of *L. quadriloba*. However, the plants differ markedly (see preceding key), particularly in the leaf shape and cell size, as well as in colour. The *L. floerkei* var. *hyperborea* is typically brown to deep brown, the *L. quadriloba* brown with a bluish-black or bluish-green cast. Therefore, in spite of the similarity in cuticular papillae and the variability in leaf-lobe number, it is presumed that var. *hyperborea* cannot be conspecific with *L. quadriloba*. Since the admixture with *L. kunzeana* (in 35366, 35366a) demonstrates conclusively that var. *hyperborea* cannot be conspecific with *L. kunzeana*, we are left with only two choices: place var. *hyperborea* as a variety of *L. floerkei*, or found a new species for it. The former procedure appears sounder at present.

I am still not convinced that the series of plants assigned to var. *hyperborea* are all uniform. One (35580) is, as Dr. Arnell indicated, "one of the dubious forms. Is it a form of *O. kunzeanus* or of *O. quadrilobus*? My opinion is that it is a form of *O. kunzeanus*. . ." Unless the plants studied by Arnell represent admixed *Lophozia* (*Orthocaulis*) *kunzeana*, not present in my sample, the large cell size would appear to exclude this species (Table I). As noted above, the admixture (in 35366) with a round-lobed variety of this last species would equally preclude identity with *L. kunzeana*. At one time I assigned the large-celled forms as varieties to both *L. floerkei* and *L. quadriloba*, and particularly with 35572 it would be readily possible to interpret it as a large-celled, possibly polyploid variant of *L. quadriloba*. For the time being, uniting the large-celled plants of the *L. floerkei-quadriloba* complex under a single name seems preferable, for reasons alluded to above.

##### 5. *Lophozia kunzeana* (Hueb.) Evs.

On relatively dry, rocky, calcareous slope, foot of Mt. Pullen (35124a).

These plants occurred on an unusually dry scree slope, under acid or at best weakly calcareous conditions, associated with *Rhacomitrium lanuginosum*, *Scapania polaris*, and *Cephaloziella arctica*. The dozen or



so plants found possessed relatively lax and distant, rather obliquely oriented leaves, and varied from green to pale brownish, with relatively weakly papillose cells. In these respects they differed markedly from the much more ubiquitous and very variable *L. quadriloba*. The very predominantly bilobed leaves, with few trifid, the sinus descending to the leaf-middle and weakly gibbous at base, and the lack of basal cilia of the leaves were also diagnostic. The underleaves were lanceolate or bifid, but essentially cilium-free. This, together with the cells (18 to 20  $\mu$  on the margins of the lobes, and nearly quadrate; 18.5 to 20  $\mu$  wide in middle and near bases of lobes and hardly longer; oil-bodies large, 4 to 5 per cell usually; trigones rather coarse to weakly bulging), appears to be definitely diagnostic of *L. kunzeana*. Although somewhat slender, the plants had the facies of this species, and the identification seems beyond question.

The species has been previously reported from farther south in Greenland and Baffin Island.

**5a. *Lophozia kunzeana* (Hueb.) Evs. var. *rotundiloba* var. n.<sup>1</sup>**

Plants rather dense-leaved, with concave, 2-lobed leaves, smooth-margined, except for an occasional, solitary tooth of postical base, the lobes bluntly rounded to broadly rounded, often decolorate at the margins. Marginal cells 17 to 18.5  $\mu$ , often subquadrate; median cells of lobes (18) 20 to 22  $\times$  21 to 25  $\mu$ ; cells of middle below sinus 20 to 25 (26)  $\times$  22 to 26 (28)  $\mu$ ; cuticle, at least locally, closely but not very coarsely, densely papillose. Underleaves lanceolate with 1 to 2 basal cilia to bifid and usually eciliate.

TYPE. Moist humus over low scarp, about one-quarter mile N. of Mt. Pullen, Ellesmere Island (mixed with *Lophozia heterocolpa*, *L. floerkei* var. *hyperborea*, *Scapania polaris*, *Eremonotus minutus*) (Schuster 35366 and 35366a; July 21, 1955).

This variant represents a dense-leaved form with very broadly rounded leaf-lobes, only isolated leaves being bluntly pointed at the tip (as is the case with the species proper). The plant is very different in aspect from the typical plants of the species reported above, although both agree in the almost uniformly bilobed leaves, with the sinus descending virtually to the leaf-middle, and in the conspicuous, although infrequently ciliate underleaves. Gemmae appear to be uniformly absent on these plants, although they may have been overlooked. At least in collection 35366a, there is admixed the deceptively similar *Lophozia floerkei* var. *hyperborea*; the separation of these two plants is readily possible when dissected leaves are carefully compared (see above).

Subgenus *LEIOCOLEA* K. Müller

**6. *Lophozia muelleri* (Lindenb.) Dumort.**

Traces among mosses, damp depressions at edges of soil-polygons, calcareous clay-shale slope, Alert (35067). Damp, calcareous polygon field, chiefly in crevices, near edge of shallow, permanent pond between Upper Dumbbell Lake and Parr Inlet, ca. 150 to 200 feet (35076). Damp,

<sup>1</sup>Similis *L. kunzeanae* sed dissimilis in late rotundatis lobis foliorum, marginibus generaliter pellucidis. Typus: Mt. Pullen, Ellesmere I. (35366 et 35366a).



calcareous clay, around rocky outcrops, around "lemming-warren", a mile S. of Alert (35080). Moist, calcareous clay-shale slope beneath persistent snowbank, 2.5 miles W. of Cape Belknap, S. of Williams Island (35201, 35204). Marshy, clay-shale calcareous slope near seashore, below persisting snowdrifts, S. of Williams Island (35210a). Moist, calcareous soil, steep slope below persisting snowbank, at S. end of Hilgard Bay (35321b, 35242). In blackish-green patches, over calcareous clay slopes, Cape Belknap, shore of Dumbbell Bay (35294, 35295a, 35296, 35296a). Moist, exposed clay slope below persistent snowbank, Cape Belknap, shore of Dumbbell Bay (35288). Moist, weakly basic steep weathered slope, valley between Peak 1 and Peak 2 ca. 5 miles SW. of end of Hilgard Bay (35521). Moist polygon field, edge of frozen Lincoln Sea, edge of polar ice-cap, foot of Cape Belknap (35754).

Although reported from central and southern Ellesmere Island (Bryhn, 1906), these collections appear to represent the northernmost ones for the species. I have regarded all plants with small underleaves and cells (with small to distinct trigones), smaller than those of *L. badensis*, which are smaller than *L. gillmani* and dioecious, as belonging to *L. muelleri*. In several collections it was impossible to prove the presence of dioecious inflorescences, but in some the compactly spicate andræcia characteristic of the species were present; in others (i.e., 35080a) gynæcia but no andræcia could be found. Many other traces of plants were found, clearly belonging to the *L. badensis-muelleri-gillmani* complex— i.e., developing the somewhat fuscous colour of the leaf-apices typical of this complex, rather than the warm brown pigmentation of *L. heterocolpa*; these plants, in most cases, could not be determined with certainty and are not reported. *L. muelleri* was found with most of the same species as *L. badensis* and *L. gillmani*: *Athalamia hyalina*, *Solenostoma polaris*, *Trichostylium pinguis*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Scapania gymnostomophila*, *Cephaloziella arctica*, *Arnellia fennica*, *Cryptocolea imbricata*, *Lophozia heterocolpa harpanthoides*, as well as with *Lophozia gillmani* and *L. badensis*. Associated mosses include mostly the common calciphiles of the low-lying coastal region (to which the *L. muelleri* is apparently confined): *Distichium capillaceum*, *Ditrichum flexicaule*, *Barbula icmadophila*, *Hypnum revolutum*, *Tortula ruralis*, *Myurella tenerrima*, *Encalypta alpina*, *E. procera*, *Anoetangium tenuinerve*, *Holmgrenia chrysea*, and *Timmia norvegica*.

## 7. *Lophozia badensis* (Gottsche) Schiffn.

Damp, calcareous slope below persistent snowbank, S. end of Hilgard Bay (35242, 35234a, 35230, 35260). Moist humus over calcareous slopes below persisting snowfield, S. end of Hilgard Bay (35235b). Over wet, calcareous clay slopes, Cape Belknap, shore of Dumbbell Bay (35295b). Exposed, damp, clay-shale polygon field, in polygon edges, base of Cape Belknap, near Alert airstrip (35827b). Damp, humus-covered, clay-stone slope, S. end of Hilgard Bay (35931a).

Plants reasonably surely referable to *L. badensis* were found only a very few times in the Alert area, although sterile and indeterminable plants which could belong to either *L. badensis* or *L. muelleri* were often found in small quantity. The species is thus probably more frequent than the collections suggest. The above collections are, in part, material mixed with



plants probably referable to *L. muelleri*. For example, in 35827b (Cape Belknap) there are some plants with very leptodermous, in part violet-black pigmented cells that average 30 to 36  $\mu$  in the lobes; other admixed plants possess cells that are smaller and hence probably represent *L. muelleri*. Similar plants (35931a; Hilgard Bay) with rather shallowly bilobed leaves had, in part, cells 30 to 35  $\mu$  in the lobes, thus were referable to *L. badensis*; others had them only 25  $\mu$  and may represent *L. muelleri*. In 35295b (Cape Belknap) small male plants were found with somewhat fuscous leaves; these were large-celled and the cells were leptodermous, compared with accompanying plants with smaller cells but obvious trigones (which were referable to *L. muelleri*). In almost all instances the plants referred to *L. badensis* lacked underleaves (although the mod. *colorata-parvifolia* with gynœcia, 35234a, had stalked slime papillae on female plants).

The species was restricted to low-lying, highly calcareous coastal areas, both on sloping, damp, moss-tundra over clay-shale and on wet or damp moss-tundra in polygon-fields; associated were usually *Lophozia pellucida*, *Solenostoma polaris*, *Cryptocolea imbricata*, *Trichostylium pinguis*, *Lophozia muelleri*, *L. heterocolpa harpanthoides*, *L. gillmani* (separable at once by the verruculose cuticle and parœcious inflorescences), *Arnellia fennica*, *Cephaloziella arctica*, *Scapania gymnostomophila*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Athalamia hyalina*, and a variety of mosses (*Fissidens arcticus*, *Barbula icmadophila*, *Didymodon recurvirostris*, *Holmgrenia stricta*, *Mnium hymenophyllum*, *Anoetangium tenuinerve*, *Aloina brevirostris*, *Encalypta procera*, *E. alpina*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Dicranella crispa*, *Didymodon rufus*, *Campylium stellatum*, *Tomenthypnum nitens*, *Timmia austriaca*, *Philonotis fontana*, and *Amblystegiella sprucei*). Associated with the exposed growth pattern, *Lophozia badensis* was usually somewhat pigmented, at least the leaf-lobes (and often the male bracts) showing somewhat fuscous or purplish-fuscous pigmentation. In spite of the exposed nature of the habitat, conspicuous trigones were never developed, nor were obvious verrucae. The plants differ in aspect from the pure green, more delicate and straggling plants usually found among *Gymnostomum* on calcareous rocks to the south.

Although reported by Bryhn (1906) from southern and central Ellesmere Island, the present collections extend the range of this species to a new northern limit.

### 8. *Lophozia gillmani* (Aust.) Schuster

Damp, clay-shale solifluction slope, below persistent snowbank, head of Parr Inlet (35152, 35154, 35155). In deep green mats, damp clay-shale, calcareous slopes below persistent snowdrifts, near seashore S. of Williams Island (35210b). Moist clay-shale polygon slopes below persisting snowfields, ca. 2 to 2.5 miles W. of Cape Belknap, S. of Williams Island (35200, 35205). Moist, snow-fed, calcareous clay-shale slope, 2.5 miles W. of Cape Belknap, mouth of Black Cliffs Bay, opposite Cape Woolen (35212). Damp calcareous slope below snowbank, S. end of Hilgard Bay (35230, 35234, 35235b, 35248). In blackish-green patches, damp, calcareous slopes, near shore of Dumbbell Bay, Cape Belknap (35294, 35296c). Moist, exposed clay slope below persistent snowbank, Cape Belknap, shore of Dumbbell Bay (35288). Calcareous clay-loam outwash plain NE. of Mt. Pullen



(35382a, 35383b). In black-green patches over exposed humus on steep, calcareous, damp clay-shale slopes, S. end of Hilgard Bay (35932d). Old musk-ox dung, wet polygon field, highly calcareous, near edge of "Lake Anxiety," SE. side of Hilgard Bay (35936).

Regarded by Steere (1937) as "Cordilleran," this species was previously known in North America from Alaska and Yukon south to Montana, in the Lake Superior region, and in Quebec and Vermont. The plants in many instances differ in aspect from those illustrated by Schuster (1953); they often form black-green patches, with the leaves antically secund and often nearly appressed. However, in all the collections reported above, paræcious inflorescences were readily determinable. The cells were about 29 to 32  $\mu$  in the leaf-lobes, 30 to 32  $\times$  36  $\mu$  in the leaf-middle; distinct underleaves were present throughout. Although perianths were freely developed, sporangia were never seen; the growing season apparently is too short for their development, except under unusually favourable conditions. Considering the frequency with which this species was found, I wonder whether some reports of *L. bantriensis* from arctic North America and Greenland may not be referable here.

*L. gillmani* was restricted to the low, calcareous plateau region, from sea-level, on the shore of the Arctic Ocean to about 500 feet elevation; it was limited to the damper, better irrigated sites, often below permanent snowbanks. Here it usually occurred in rather rich moss-tundra, associated with a wide variety of hepatics, among them *Arnellia fennica*, *Cryptocolea imbricata*, *Lophozia quadriloba*, *L. heterocolpa* (and var. *harpanthoides*), *Blepharostoma trichophyllum* ssp. *brevirete*, *Scapania gymnostomophila*, *Trichostylium pinguis*, *Lophozia muelleri*, *L. badensis*, *Solenostoma polaris*, *Lophozia pellucida*, and *Cephaloziella arctica*; associated mosses were *Holmgrenia chrysea*, *H. stricta*, *Barbula icmadophila*, *Timmia norvegica*, *T. austriaca*, *Philonotis fontana*, *Ditrichum flexicaule*, *Mnium hymenophyllum*, *Polyptrichum alpinum*, *Distichium capillaceum*, *Myurella julacea*, *Campylium stellatum*, *Encalypta alpina*, *Anoetangium tenuinerve*, *Isopterygium pulchellum*, *Amblystegiella sprucei*, and *Tomenthypnum nitens*.

One of the collections cited above (35200) may be worthy of nomenclatural recognition. It has the normal paræcious inflorescences of the species, but the perianths are very atypical; they are essentially erostrate, more or less incised at the mouth, and in part ciliolate.

## 9. *Lophozia heterocolpa* (Thed.) Howe

Moist, weakly basic humus, clay-shale talus slope, foot of Mt. Pullen (35102d, 35121; c. per., gem.). Over damp, mossy bank, below snowbank, N. slope of Mt. Pullen (35103f). Moist damp slope, beneath persisting snowfield, on The Dean (35160, 35160a, 35169, 35169a, 35188). Damp, peaty soil over basic, weathered, snow-fed slopes, Mt. Pullen (35307b, 35307d). Damp, calcareous, humus-covered clay shale, low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen (35370, c. gem.; 35376a). Damp humus, snow-fed, weakly basic slopes of The Dean (35407, 35407a). Chestnut-pigmented plants, over humus, calcareous, moist, snow-fed clay-shale slope, SW. end of Mt. Pullen (35792b, 35795b, 35797).



These plants are usually light green to more or less warmly brownish-tinged, with brownish or fulvous-brown gemmae; in spite of being dioecious, they are frequently provided with perianths and are always very freely gemmiparous. Neither the typical plants nor the questionable var. *harpanthoides* has been previously reported from latitudes as high as those of northern Ellesmere Island.

*L. heterocolpa* is often a relatively conspicuous constituent of richer, denser, moss-tundra areas, lying over calcareous clay-shale slopes. Therefore, although locally common, it is found in very few sites in the Alert region. Associated hepatics include *Tritomaria quinquedentata*, *T. heterophylla*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, *Cryptocolea imbricata*, *Lophozia alpestris major*, *L. quadriloba*, *Arnellia fennica*, *Anthelia juratzkana*, *Scapania polaris*, *Plagiochila arctica*. Associated mosses are largely the same as are found with var. *harpanthoides*.

**9a. *Lophozia heterocolpa* var. *harpanthoides* (Bryhn & Kaalaas) Schust.**

*Lophozia harpanthoides* Bryhn & Kaalaas, in Bryhn, Rept. 2nd Norwegian Exped. in the "Fram," 11: 31, 1906.

*Leiocolea heterocolpa* var. *harpanthoides* Schuster ex Arnell, Ills. Moss Fl. Fennosc. 1: 112, 1956.

*Leiocolea arctica* Arnell, Svensk. Bot. Tidskr. 44: 374, 1950.

Damp, weakly basic humus over steep, weathered slope, S. end of Hilgard Bay (35225, 35256). In clear brown patches, over damp calcareous slope, on thin humus, below snowfield, S. end of Hilgard Bay (35250, 35231a). Calcareous clay-loam outwash plain NE. of Mt. Pullen (35383, 35383a). Over snow-fed, moist, peaty humus, over basic, weathered slopes, Mt. Pullen (35306, 35306a, 35307b, 35307e). Exposed, thin, peaty soil over basic, weathered slope of NE. side of Mt. Pullen (35315). In brownish patches over damp, clay-shale slope, edge of frozen polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35626b, 35633a, 35634, 35634a, 35634b, 35638b). Damp, exposed, calcareous moss-covered clay-shale slope at edge of frozen Lincoln Sea, peripheral to polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35751). Humus-covered, damp, snow-fed, calcareous clay-shale slope, SW. side of Mt. Pullen (35762b, 35792c, 35792a). Damp, humus-covered, calcareous clay-shale slope, S. end of Hilgard Bay (35931b, 35932c).

The plants of the present form represent a considerable taxonomic problem. They appear to correspond rather closely to the originals of Bryhn and Kaalaas, in that they are deeply pigmented, with the apices of the usually erect shoots carmine to reddish-purple tinged; even on clear green plants there is some tendency for such pigmentation of the shoot apex. In sun forms, the plants acquire a chestnut colour, and in mass may appear almost blackish. The cell-walls, in such phases, appear strongly yellowish. Associated with this, the gemmae are either rare or lacking (if present usually strongly reddish to reddish-purple), and the trigones are exceedingly coarse.

Unfortunately these plants appear to grade into typical *L. heterocolpa* in all respects. For example, the plants of 35795b represent a phase in which the plants are chestnut-pigmented, yet the gemmae are pale fulvous-brown;



in 35231a, the plants are very similar in pigmentation to "normal" *L. heterocolpa*, yet gemmae are lacking. However, the other collections assigned to var. *harpanthoides* are quite typical and rather uniform in appearance. They are almost all (e.g. 35315, 35626b, 35634, 35931b, 35751, 35638b) annotated as "totally gemmae-free" or "quite devoid of gemmae." Only one collection (35792a) shows the reddish to purplish gemmae supposedly characteristic of this taxon, and there they are infrequently produced, as Frye & Clark (loc. cit., p. 387) emphasize. In spite of the fact that "*L. harpanthoides*" appears to possess a rather distinctive ensemble of characters, it still remains to be proved whether or not the plant is more than a mod. *colorata-pachyderma* of *L. heterocolpa*. The plants of 35307e (Mt. Pullen) fail to provide an absolute answer: they are typical "*harpanthoides*"—strongly pigmented and gemmae-free, although freely provided with perianths and andrœcia. Yet they occurred almost juxtaposed to ordinary *L. heterocolpa* (in 35307b). Further field observations, and preferably culture experiments, are needed to demonstrate that the two plants, when growing intermingled, maintain their distinctive features.

The var. *harpanthoides* does not appear to be completely identical with *Leiocolea arctica* S. Arnell (1950), which is described as having the marginal cells as 20 to 30  $\mu$ , and as possessing ("probably") 16 chromosomes. This may be a polyploid race, and it seems premature, as Arnell (1956) has done, to equate the two.<sup>1</sup>

The pigmented, nearly or quite gemma-free plants I refer to var. *harpanthoides* occur under essentially equivalent conditions as the parent species; associated are, variously, *Tritomaria quinquedentata*, *T. heterophylla*, *Odontoschisma macounii*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Anthelia juratzkana*, *Lophozia pellucida*, *L. quadriloba*, *Arnellia fennica*, *Cryptocolea imbricata*, *Cephaloziella arctica*, *Scapania gymnostomophila*, *Lophozia badensis*, *L. muelleri*, *L. gillmani*, *Hypnum callichroum*, *Timmia austriaca*, *Philonotis fontana*, *Aulacomnium turgidum*, *Barbula icmadophila*, *Distichium capillaceum*, *Ditrichum flexicaule*, *Polytrichum alpinum*, *Drepanocladus uncinatus*, *Hylocomium splendens*, *Holmgrenia chrysea*, *H. stricta*, *Pohlia cruda*, *Bartramia ithyphylla*, *Campylium stellatum*, *Tomenthypnum nitens*, *Anoetangium tenuinerve*, *Encalypta alpina*, *Amblystegiella sprucei*, *Didymodon recurvirostris*.

#### Subgenus MASSULA K. Müller

### 10. *Lophozia hyperarctica* Schuster

Wet, calcareous polygon field, edge of intermittent pool bordered by *Drepanocladus*, etc., in flat between Upper Dumbbell Lake and Parr Inlet (35072a [= 35077]). Wet polygon, clay-shale field, edge of temporary pond, between Alert and Upper Dumbbell Lake (35061, 35063a). Wet, calcareous, clay-shale solifluction slope, head of Parr Inlet (35142).

The present species, unfortunately found in only very small quantity, was restricted in occurrence, being found only on the clay-shale, wet, highly calcareous, low polygon fields and the ecologically similar, calcareous, clay solifluction slopes in the immediate vicinity of Alert. Associated were

<sup>1</sup>Dr. Arnell (in litt.) believes that 35250 is "the same as my var. *arctica*. So perhaps the name should be *L. harpanthoides* and my name only a synonym." For the time being, until the status of the three putative taxa can be clarified, it seems best to maintain *L. arctica* (or *L. heterocolpa* var. *arctica*), *L. heterocolpa*, and *L. heterocolpa* var. *harpanthoides* as separate concepts.



*Solenostoma polaris*, *Scapania gymnostomophila*, *Athalamia hyalina*, *Trichostylium pinguis*, *Cephaloziella arctica* and *Blepharostoma trichophyllum* ssp. *brevirete*—a series of tolerant, highly calciphilous taxa. Among the associated mosses, most notable were *Tortula ruralis*, *Hypnum revolutum*, *H. vaucheri*, *Ditrichum flexicaule*, *Distichium capillaceum*, and *Barbula icmadophila*. The plant is apparently always a hygrophyte, occurring at the bases of the culms of *Juncus biglumis* and *Alopecurus alpinus*, in low swales and at the edges of shallow pools, associated with *Eriophorum scheuchzeri*.

*L. hyperarctica*, described only recently from the above collections (Schuster, 1959b) serves in some way to connect the subgenera *Lophozia* and *Massula*. The oil-bodies commonly range from 18 to 24 per cell and are very small, but finely granular. The leaves, as in other species of *Massula*, tend to be irregularly 2- to 3-lobed and are often pluristratose basally; the cells tend to become equally thick-walled. The ventral half of the stem medulla is formed of homogeneous, nonmycorrhizal cells, although the cell-walls are fuscous-pigmented. The polygonal gemmae suggest *L. incisa*, from which this species differs in the segmented oil-bodies and the marked tendency, in sun forms, for the development of yellow-brown pigmentation of the leaves. The species is not known from other stations, although a few plants apparently referable to it have been found as a slight admixture in material collected near Thule, Greenland.

#### 10. *Lophozia opacifolia* Culmann

Over basic, weathered slope, clay-shale, on humus, below long persisting snowbank, foot of Mt. Pullen (35104a)

The single collection of this plant consists of only three stems which are, however, so thoroughly typical that the identification of the plant cannot be doubted. The fleshy stems are flattened and strongly elliptical in section; the leaves are short and exceedingly broad, up to 2 to 2.5 times as wide as long, usually subequally 3- to 4-lobed, with very slightly mucronate-apiculate lobes. The cells each have numerous minute, homogeneous oil-bodies, exactly as is characteristic of the species. The plants are gemmiparous. Associated species are *Odontoschisma macounii*, *Cephaloziella arctica*, *Anthelia juratzkana*, *Tritomaria heterophylla*, and *T. quinquedentata*.

*L. opacifolia* has not been previously reported from the New World. It was known, for some time, only from central Europe (Switzerland, N. Italy, Austria) but has recently been reported from Scandinavia and Scotland. The species appears to be a derivative of *L. incisa*, and appears restricted to alpine and arctic sites. It exhibits the same bluish-green colour as does *L. incisa*, differing from it chiefly in the shorter, broader, thicker and more rigid leaves, in the lack of spinous teeth of the leaves, and in the subentire perianth mouth. The species must be extraordinarily rare in the Alert region; it was recognized early in the collecting season and sought repeatedly thereafter without success. The illustrations in Schuster 1959b are derived from these plants; they give an adequate idea of the morphology of the plant. Judging from the associated species, the plant is more lime-tolerant than *L. incisa*. It is of interest that Müller (1951-1958, p. 682) emphasizes that the plant occurs in Europe "auf Erde, die lange vom Schnee bedeckt ist. . . ."



## Subgenus LOPHOZIA Dumort.

As in other cool and cold portions of the northern Hemisphere, the species of the subgenus *Lophozia* ("Dilophozia" of Müller) are technical, and, except for *L. excisa* and *L. latifolia*, almost always sterile. The colour of the gemmae is of critical importance for their identification, as is the nature of the oil-bodies. Since the latter must be studied from recently collected plants, the following data should prove of value, as the material reported below was microscopically examined while living. Reports in this subgenus are no better than the species concepts on which they are based. The following key to the taxa encountered in northern Ellesmere Island is therefore given.

1. Gemmae, at least in sun forms, brownish or reddish; cells usually larger, in the lobes 23-30 or up to 35-40  $\mu$ ; oil-bodies of numerous, fine, uniform spherules . . . . 2.
2. Gemmae reddish, deeply pigmented, or purplish-red (even in shade forms); leaves, at least locally, reddish-brown to carmine red, in sun forms . . . . . 3.
3. Leaves nearly flat; plants not fleshy, rarely with gynœcia, almost uniformly sterile; diœcious. *L. alpestris major*
3. Leaves, at least the upper, more or less concave, often fluted on fertile plants; plants fleshy, usually freely fertile . . . . . 4.
4. Diœcious; andrœcia slender, spicate, the bracts 1-androus; leaves with sinus deep, lobes usually acute; gemmae usually infrequent. *L. latifolia*
4. Parœcious; andrœcia of 1-3 pairs of large, shallowly concave bracts, usually 2-3 (4)-androus; leaves usually with sinus shallow, lobes obtuse; gemmae abundant. *L. excisa*
2. Gemmae in sun forms yellowish-brown, the leaves (at least distally) similarly pigmented; shade forms green throughout, with greenish gemmae; diœcious and always sterile (locally) . . . . . 5.
5. Cells very large: the marginal and subapical 35-40  $\times$  35-50  $\mu$ ; median cells (33) 35-42 (45)  $\times$  40-50 (55)  $\mu$ ; lobes often obtuse or rounded. *L. pellucida*
5. Cells small: the marginal and subapical 23-32 (35)  $\mu$ ; median 25-30  $\times$  30-38  $\mu$ ; leaf-lobes consistently acute or subacute. *L. pellucida* var. *minor*
1. Gemmae yellowish-green (even when plants otherwise strongly pigmented); diœcious; cells in lobes 20-25  $\mu$  . . . . . 6.
6. Cells with (3-5) 6-13 (14-15) oil-bodies formed of numerous, similar spherules; leaves with sinus often extending to  $\frac{1}{4}$ - $\frac{1}{3}$ , averaging 0.95-1.1 times as wide as long; stems not reddish-tinged ventrally. *L. ventricosa*
6. Cells with (8-10) 12-15 (17-18) oil-bodies formed of an outer mantle of minute globules, surrounding a central homogeneous sphere (thus biconcentric); leaves consistently shallowly bilobed, concave, to  $\frac{1}{5}$ - $\frac{1}{4}$  bilobed, 1.1-1.2 times as wide as long; stem reddish-tinged ventrally. *L. groenlandica*

12. *Lophozia latifolia* Schuster

Steep, weathered slope of The Dean, ca. 82°26' N; 62°05' W. (35405). Steep scree slope, snow-fed, ca. 2,000 feet, 6 to 7 miles WNW. of Peak 1 (35579b, 35559, 35576). This species was recently described (Schuster, 1953a) from a single station in northeastern Minnesota. Arnell (1956) has recently found it in several localities in northernmost Sweden and Norway.



The first collection cited above is critical in several respects. The plants closely match the type material, except that the plants are more compact and somewhat reddish-pigmented (mod. *densifolia-colorata*). Several male plants, with narrow, spicate andræcia were found, and about a dozen female plants examined, all of which quite lacked antheridial bracts below the gynœcia. These plants, as is common with xeromorphic phases of the various species of *Lophozia*, had slightly smaller cells and fewer oil-bodies than the hygrophytic type material. Median cells had from (5 to 7) 8 to 12 (13 to 15) oil-bodies. The average number of oil-bodies (42 cells) was 10.3 per cell.

Associated with these highly pigmented dioecious plants were a few plants of the very closely allied *L. excisa*, which were somewhat more robust, less strongly pigmented (a little carmine-red along the leaf-margins, otherwise green), and bore gemmae freely. The *L. latifolia* plants were nearly or quite devoid of gemmae. In the *L. excisa* the cells averaged from (8 to 13) 14 to 23 (25 to 28) oil-bodies per median cell. The average number of oil-bodies (14 cells) was 18.1.

In view of the fact that *L. latifolia* is so closely allied to *L. excisa*, the occurrence of the two together is difficult to interpret. It may indicate that either a single "typus polymorphus" is involved, or that the two species are distinct even when occurring intermingled, i.e., the differences between them are not environmentally induced.

The plants of the second collection (35579b) are without exception all female. Although perianths are absent, gynœcia are common. The plants closely match the preceding collection in (a) lack of gemmae; (b) intensive, dull brick-red pigmentation; (c) deeply (to two-fifths) bilobed leaves with an acute to rectangulate, often reflexed sinus. The plants are somewhat less xeromorphic and have, on the average, more numerous oil-bodies. The consistent absence or rarity of gemmae is notable! In all collections of true *L. excisa* from the same area, gemmae are very abundantly produced on the mod. *colorata*, which is the predominant one.

Plants from the same locality (35559) are very abundant and well developed, being much more copious than the type material. In over 80 cases examined, the plants were clearly dioecious; in two cases, ramified male plants (with "normal" slenderly spicate andræcia, bearing saccate, monandrous bracts as in the type plants) were found in which the apices of the andræcia were followed by several pairs of vegetative leaves, beyond which occurred a terminal gynœcium. Such heterœcious plants appear to be exceptional.

As is evident from the foregoing, occasional bisexual individuals occur also in *L. latifolia*, if only exceptionally so. Yet such plants are abundantly distinct from *L. excisa* in the deeply bilobed, quadrate to rectangulate leaves, with a sharp to rectangulate, often reflexed or gibbous sinus, and sharp lobes, and the rarity or even absence of gemmae.

In *L. latifolia* the female bracts, though very polymorphous, lack sharp, scattered marginal teeth. In *L. excisa* such teeth are always present, though often few in number.

Associated closely with the *L. latifolia* in the present collection was a small patch of *L. excisa* (in 35559a). The plants of the latter were at once separate in (a) restriction of pigmentation to the periphery of the



leaf-margins, the plants being greener and softer-textured; (b) very abundant gemmae production; (c) the leaves shallowly bilobed, the sinus usually crescentic; (d) the 2 to 3 pairs of large, weakly concave leaves below the gynœcia with 2 to 3 antheridia each, only isolated bracts 1-androus; (e) the female bracts with their lobes and margins with at least occasional sharp teeth. Not a single purely antheridial shoot could be found.

In the close association of the two species and in the closely parallel range of differences noted, the present collection is identical in all respects with that from The Dean (35405).

Associated hepatics, in addition to *L. excisa*, are *Eremonotus minutus* var. *grandis* and *Tritomaria quinquedentata*; associated mosses are (in 35405) *Bartramia ithyphylla*, *Bryum arcticum*, and *Pohlia cruda*. The plant appears restricted to noncalcareous or very weakly calcareous areas.

### 13. *Lophozia excisa* (Dicks.) Dumort.

Among mosses, damp, snow-fed calcareous slope, Mt. Pullen (35118, 35118c). Exposed humus over basic shale slope, NW. slope of The Dean (35158). Over weakly basic humus, snow-fed slope at foot of The Dean (35179). Damp, weakly basic, exposed, humus-covered slopes of Mt. Pullen (35342, 35343, 35354a). Over rather dry, exposed, weakly basic, weathered slope of Mt. Pullen (35324a, 35340a). Damp humus, steep weathered slopes of The Dean, ca. 900 feet (35397a). In a small patch, among mosses, exposed, humus-covered weathered slope of The Dean (35405). Damp rocks in small ravine on S. side of Hilgard Bay (35478). Scattered, small, green patches, among mosses on humus, weathered, basic, snow-fed scree slope, ca. 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35559a, 35586a; c. per.).

Northernmost report of the species in the Canadian Arctic; otherwise known from Harbour and Goose fiords, on the South Coast (Bryhn, 1906). Hesselbo (1923) reported the species from northeastern Greenland at lat. 82°44' N., a few miles farther northward than the Ellesmere reports (which are from 82°26' N.).

The species is lime-tolerant northward and is often found associated with *Lophozia* (*Orthocaulis*) *quadriloba* and *Cephalozia arctica*, species with which it occurs as far southward as the northern tip of Michigan (Schuster, 1953).

The plant occurs, in northeastern Ellesmere Island, with the closely allied *Lophozia latifolia*. It appears to differ from this rather constantly in the parœcious inflorescence and free production of gemmae. The plants are generally relatively large, although very compact and very fleshy, the leaves often being 2-stratose in their basal portions. Such plants, when growing in strongly insolated sites, have concave leaves, a brownish-purple pigmentation that may be so intense that the plants, in patches, look blackish when examined in reflected light. The gemmae in such plants are deep purplish-brown and unusual in being slightly thick-walled.

The arctic phases differ widely in the antheridial stalk. In 35118 all of dozens of examined antheridia had uniseriate stalks; in 35158 most



antheridia possess uniseriate stalks, a few had isolated cells longitudinally divided, and one or two had almost wholly biseriate stalks. The emphasis placed by Müller (1948) on this feature thus appears misapplied.

#### 14. *Lophozia pellucida* Schuster

South end of Parr Inlet, Dumbbell Bay, on snow-fed, calcareous solifluction slope, ca. 1 mile S. of Alert (35141, type! 35141c, 35151); clay-shale slope, below permanent snowbank, Mt. Pullen, 800 to 900 feet (35786, 35768a, 35312); clay-shale, calcareous flat, outwash plain N. of Mt. Pullen (35382a); steep, moist, mossy, stabilized clay-shale scree slope, S. end of Hilgard Bay (35931, 35934a); calcareous clay slope fed by hanging snowbank, 1.5 to 2.5 miles W. of Cape Belknap, adjoining mouth of Colan Bay at edge of Polar Sea (35205a, 35213, 35205, 35207, 35208, 35634a, 35634b, 35626, 35638a p.p.); clay-shale slope, valley between Peak 1 and Peak 2, SW. of head of Hilgard Bay (35549, 35549a, 35520, 35520a); NW. side of The Dean (35167). Damp, calcareous solifluction slope, shore of Hilgard Bay (35260).

This recently described species (Schuster, 1959b) is chiefly characterized by the very large and pellucid cells, the broad, nearly horizontal leaves, and the light, brownish gemmae. The plants can be mistaken, superficially, for *Lophozia alpestris* var. *major* but have even larger cells and much paler gemmae. The plants usually occur loosely scattered, on wet, rather than merely damp, snow-fed, calcareous clay slopes. Associated commonly are *Trichostylium pinguis*, *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, *Lophozia gillmani*, *L. muelleri*, *L. badensis*, *Athalamia hyalina*, *Sauteria alpina*, *Preissia quadrata*, and the mosses *Drepanocladus revolvens*, *Holmgrenia chrysea*, *Hypnum bambergeri*, *Distichium capillaceum*, *Catolopodium nigritum*, *Barbula icmadophila*, *Cinclidium arcticum*, *Philonotis fontana*, *Pohlia cruda*, *Ditrichum flexicaule*, *Myurella julacea*, *Polytrichum alpinum*, *Tortula ruralis*, *Timmia norvegica*, *Dichodontium pellucidum*, *Bryobrittonia pellucida*, and *Didymodon recurvirostris*. At Colan Bay the species is intimately associated with *Equisetum variegatum* at its northernmost station.

#### 14a. *Lophozia pellucida* var. *minor* Schuster

Rocky slope above Parr Inlet, ca. 250 to 300 feet around a "lemming-warren," one mile S. of Alert (35070a). Among mosses, damp, calcareous, clay-shale slope, near shore of permanent ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35626, 35626a, 35632, 35634c, 35638, 35638a). Moist, moss-tundra, calcareous clay slope, just above beach of frozen Lincoln Sea, 2 miles W. of tip of Cape Belknap (35817a, 35238, 35820, 35824). Plants from the following two stations are less typically developed but cannot be referred elsewhere: damp, weakly basic, steep, clay-shale sandstone slope, below persisting snowbank, S. end of Hilgard Bay (35231, 35237). Among mosses, on damp, clay-shale, calcareous edge of low scarp, edge of persistent snow-ice-field, one-quarter mile N. of Mt. Pullen (35369). Both the species and the present variety are, to date, known only from the Alert area.

*L. pellucida* var. *minor* represents a local, smaller-celled phase of the very large-celled *L. pellucida* (Schuster, 1959b). The plants growing under more nearly sheltered conditions tend to show little pigmentation, and the



gemmae are hardly yellow-brown in extreme instances. However, even in the three questionable collections, cited last above, the gemmae were noted to be "yellowish or yellow-brown" and "gemmae at least in part pale yellow-brown, as are the leaf-lobes." When pigmentation is very poorly developed, the plants would tend to be confused with a large-celled form of *Lophozia ventricosa*, which has almost exactly similar, ovoid to subspherical oil-bodies, lacking a central highly refractive sphere. On the other hand, the var. *minor* not infrequently occurs with typical *L. pellucida*, especially in the collections west of Cape Belknap, and in several instances appear to grade into typical *L. pellucida*. This is the case, for example, in 35820, in which the cells of the leaf-apices are, in part, 28 to 36  $\mu$  in diameter, and in 35638, in which the cells of the leaf-tips are 23 to 28, rarely 30  $\mu$  in diameter. Under normal conditions, the much inferior cell-size, as compared with typical *L. pellucida*, together with the weakly but distinctly pigmented gemmae, serve to adequately circumscribe var. *minor*. The plants are usually restricted to sites less strongly irrigated than those typical for *L. pellucida*; both tend to occur below permanent snowbanks. Commonly associated are *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, *Solenostoma polaris*, *Lophozia quadriloba*, *Lophozia heterocolpa*, and var. *harpanthoides*, rarely *Moerkia flotowiana*, *Cryptocolea imbricata*, *Lophozia muelleri*, and *Scapania gymnostomophila*.

Known only from the localities given above.

#### 15. *Lophozia alpestris* (Schleich.) Evs.

Damp humus, basic weathered slopes of Mt. Pullen (35302a).

Typical *L. alpestris* is apparently very infrequent or rare in the Alert area, being very largely replaced by the presumed polyploid variant var. *major* (q.v.). The above is the only collection which can be surely assigned to typical *L. alpestris*. The plants occurred admixed with *L. excisa*, with which confusion might easily arise, but in *L. alpestris* the cells are much smaller (14 to 16, occasionally 16 to 18  $\mu$  along the margins of the gemmae-free lobes; 18 to 21  $\mu$  in the lobes; medially hardly larger and remaining nearly isodiametric), the size difference being apparent under the low-power binocular microscope. Furthermore, the *L. alpestris* has the leaves distally somewhat brownish tinged, the cell-walls being yellow-brown, and distinct trigones are present; in the intimately admixed *L. excisa* the leaves are a clear, pale green except for the lobes and sometimes cells along the sinuses, which are a characteristic carmine red. The gemmae in both the *L. alpestris* and *L. excisa* are reddish to almost vinaceous red; in the *L. alpestris* they average 18 to 22.5 (24)  $\mu$ . The small cell size of typical *L. alpestris* is not related to the vigour of the plant. For example, in 35762, also from Mt. Pullen, containing *L. alpestris* var. *major*, the plants are much less vigorous, a subjulaceous phase with antically somewhat secund leaves. In these plants the cells were much larger, the marginal and lobar cells averaging 26 to 30  $\mu$ , the median hardly larger. The gemmae in these plants averaged from subquadrate to polygonal and 23 to 25 (28)  $\times$  25 to 28 (30)  $\mu$  to polygonal-oblong and 24 to 26  $\times$  32 to 36  $\mu$ .

Associated Hepaticae, with the *L. alpestris*, include *Anthelia juratzkana*, *Eremonotus minutus*, *Scapania polaris*, *Cephaloziella arctica*, as well as *Lophozia excisa*. As far as known, this represents the northernmost station for typical *L. alpestris*.



**15a. *Lophozia alpestris* var. *major* (Jensen) K. Müller**

Among mosses, damp talus slope and on damp clay-shale slope, at foot of Mt. Pullen, below persisting snowbank (35104c, 35111a, 35110, 35123, 35129). Damp, moss-covered humus over weathered slope, below snowbank, N. slope of Mt. Pullen (35103f, 35116). Damp, weakly basic slope, below foot of Mt. Pullen (35101e). Moist, weakly basic moss-heath below persistent snowbank, The Dean (35180, 35180a, 35182, 35186). Among *Drepanocladus* and other mosses on a basic solifluction slope, shallow gorge below snowbank, NW. side of The Dean (35167a). Moist, calcareous clay slopes, below persistent snowbank, Cape Belknap, along Dumbbell Bay (35291, 35293). Among mosses, wet, springy, basic, weathered slope, foot of Mt. Pullen (35312). In patches, over weakly basic humus, snow-fed slopes of The Dean (35409b). Among mosses, on damp, weakly basic, snow-fed scree slope, 1,800 to 2,200 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35584). Damp, moss-covered scree slope, 2,000 to 2,400 feet, E. edge of U.S. Range (35616). Open, snow-fed scree slope, moist exposed soil, ca. 2,000 to 2,400 feet, E. edge of U.S. Range, and S. of middle fork of Wood Creek, ca. 9 miles due W. of Peak 1 (35555a, 35595a). Moist, calcareous clay-shale slope, SW. base of Mt. Pullen, 800 to 1,000 feet ca. 5 to 6 miles S. of Alert (35762, 35762a, 35762b, 35783a). Cold, moist, steep, snow-fed, locally humus-covered scree slope, hills SW. of Mt. Pullen (35732, 35733). Among mosses, on saturated, snow-fed, gentle clay-shale slope, W. face of Mt. Pullen, ca. 800 to 900 feet (35786).

The northernmost known stations for the species and variety; otherwise known only from Greenland (Jensen, 1906) and Torne Lappmark, Sweden (Arnell, 1956).

Restricted to damp or intermittently dry, deep, mossy tundra, and to moss-covered, snow-fed scree slopes, often in damp depressions. At least on northern Ellesmere appearing to be weakly calciphytic, quite unlike *L. alpestris* proper. The flat, deeply lobed leaves, and the large cells and gemmae suggest a wholly distinct species may be at hand. In any event, none of the plants from northern Ellesmere Island match the alpine phases studied from farther southward. Sterile plants are likely to be mistaken for *L. excisa*, which is, however, a softer, fleshier, more tender plant, and has (in sun forms) duller, more purplish, rather than reddish, gemmae; it is furthermore almost impossible to find sterile phases of *L. excisa*, while *L. alpestris* var. *major* is usually sterile, rarely producing juvenile perianths. I have seen no male plants or fertilized perianths. The supposition (Frye & Clark, 1945) that the latter is identical with *L. wenzelii* is quite without foundation. Gemmae colour and the deeper leaf-sinus alone prohibit a close affinity.

Associated locally with the hepatics *Tritomaria quinquedentata*, *T. heterophylla*, *Scapania polaris*, *Arnellia fennica*, *Cephaloziella arctica*, *Lophozia quadriloba*, *L. heterocolpa*, *Anthelia juratzkana*, *Eremonotus minutus*, and occasionally with *Cryptocolea imbricata*. The plant almost never occurs directly on rocks and is usually somewhat hygrophytic. It is particularly common at the permanently wet "heads" of small mountain valleys filled with firn-ice; here it may occur in sites with the permafrost only 2 to 3 inches below the mat surface, and with the snow-free



period less than 10 to 12 weeks per year. Associated mosses are commonly *Anoetangium tenuinerve*, *Hypnum bambergeri*, *Ditrichum flexicaule*, *Bryum arcticum*, *Bartramia ithyphylla*, *Philonotis fontana*, *Myurella julacea* and *tenerrima*, *Polytrichum alpinum*, *Pohlia cruda*, *Tortula ruralis*, *Timmia austriaca*, *Didymodon recurvirostris*, *Drepanocladus uncinatus*, *Isopterygium pulchellum*, *Mnium orthorhynchum*, *Tomenthypnum nitens*, *Cirriphyllum cirrosum*, *Holmgrenia chrysea*, *Hylocomium splendens*, etc.

The var. *major* is reported by Arnell (1956) as "frequently growing among *Sphagnum*" and as being a "large, yellowish-green form. . ." Although at lower latitudes the plant may occur under such conditions, and may then be laxer, larger, and pale in colour in the Alert region (where *Sphagnum* is absent), the variety occurs under usually subcalcareous to distinctly calcareous conditions (as is evident from the list of associates). It then is also frequently pigmented with brownish or reddish-brown on at least the distal portions of the leaves. The plants may have a very thick stem, be subjulaceous, with the broadly orbicular leaves imbricate, slightly antically secund, strongly saucer-shaped and concave, resulting in a compact appearance. Such differences appear clearly environmental in origin and certainly do not preclude the Alert material from being identical with the original material from Greenland. The combination of large, reddish-brown or reddish gemmae and large cells with rather small trigones is diagnostic, as is the dioecious inflorescence. S. Arnell (in litt.), who has studied much of my material, believes that several examples may belong to *L. excisa* var. *grandiretis* S. Arnell. The latter is a plant with the marginal leaf-cells  $30 \times 30$  to  $40 \mu$  and about  $30 \times 50 \mu$  in the leaf-middle; the gemmae are described as being "orange-colourless." The plants here assigned to *L. alpestris* var. *major* are, however, nearly always sterile, with only a few plants found with unfertilized gynœcia; they have smaller cells, not attaining  $30 \mu$  in the leaf-tips, and the gemmae are very strikingly and deeply pigmented. More importantly, the leaves never possess the carmine pigmentation characteristic of *L. excisa*, but when developing pigmentation, are somewhat brownish-pigmented, with yellow-brown cell-walls. For that reason I am convinced that our material is closer to Jensen's var. *major* than to *L. excisa* var. *grandiretis*.<sup>1</sup>

**16. *Lophozia groenlandica* (Nees, in G.L. & N.) Macoun ?*Lophozia murmanica* Kaal., in Bryhn (1906)**

The Dean, on mossy, damp, stabilized scree slope (35393). Associated with the mosses *Racomitrium lanuginosum*, *Hylocomium splendens*, *Aulacomnium turgidum*, *Timmia austriaca*, and *Hypnum callichroum*, and the hepatics *Eremonotus minutus*, *Tritomaria quinquedentata*, *Lophozia alpestris* var. *major*, and *Cephaloziella arctica*.

This species has been greatly misunderstood. It is still not fully clear that this is the correct name to be applied to it. The plant has been generally considered a synonym of *Lophozia wenzelii*, with which it agrees in the quadrate-rotund, broad leaves with a very shallow, crescentic sinus, and in the greenish gemmae. However, the plant has biconcentric oil-bodies identical to those produced by *L. silvicola*. With crowding, also, the leaves

<sup>1</sup>Of several specimens submitted to Dr. Arnell, No. 35584 he believed to be the large-celled form of *L. excisa*, while with regard to 35186, sent as *L. alpestris* var. *major*, he is "of the same opinion," i.e., would also place it as var. *major*. In critical cases it may be necessary, in this complex, to rely on sex for a definite determination.



are characteristically antically secund and somewhat concave, the plant as a whole appearing strongly convex when viewed postically. The oil-bodies, in the Ellesmere plants, averaged 12 to 15, rarely to 17 or 18 per cell; they were thus a little less frequent than in *L. silvicola*.

This appears to be the northernmost report of the species. It has been recently reported and illustrated from northern Minnesota as *Lophozia wenzelii* (Schuster, 1953). The biconcentric oil-bodies, however, serve to separate the species from *L. wenzelii*. I had earlier (Schuster, loc. cit.) suggested the possibility of the Minnesota plant belonging to *L. groenlandica*. This species has also recently been found at Pictured Rocks, Michigan (39294). At none of the three localities at which I have found it does it occur under calcareous or subcalcareous conditions.

#### 17. *Lophozia ventricosa* (Dicks.) Dumort.

In patches over peaty soil lying over steep, weathered slopes, ca. 800 feet, The Dean (35406). Barely damp, humus-covered, greatly weathered slopes of The Dean, at ca. 750 to 800 feet (35401).

The two present collections represent the northernmost reports of this species which can be safely accepted. Since Buch split off the questionably distinct *L. silvicola*, all reports of *L. ventricosa* not based on cytological study have become open to question. The plants of the present collections bear, respectively, (5 to 7) 9 to 15 (16) oil-bodies, and (6) 9 to 12 (14) oil-bodies per cell. These oil-bodies are formed, in all instances, of uniform, minute spheres and thus lack a highly refractive central sphere. The plants occurred in somewhat caespitose patches, adjacent to *L. groenlandica*, amidst mosses (*Dicranella crista*, *Pohlia cruda*, *Polytrichum alpinum*, *Bartramia ithyphylla*), with several other Hepaticae, among them *Tritomaria quinque-dentata*, *Scapania polaris*, *Lophozia alpestris* var. *major*, *Anthelia juratzkana*, *Eremonotus minutus*, and *Cephaloziella arctica*. The plants represent an xeromorphic phase, a mod. *parvifolia-densifolia* with antically secund, concave, imbricate leaves that are clearly wider than long. In the same locality, and within a very few feet, occurred *Lophozia groenlandica*, a superficially very similar plant. However, the latter had biconcentric oil-bodies, averaging 12 to 15, rarely 17 to 18 per cell. Both of these species bore yellow-green gemmae, which showed no trace of pigmentation, in spite of the tendency for the leaf-lobes to develop yellowish to yellow-brown pigmentation.

TRITOMARIA Schiffn.

#### 18. *Tritomaria heterophylla* Schuster

Damp, moss-*Saxifraga* heath, snow-fed talus slope, foot of Mt. Pullen (35102). Damp, moss-covered talus slope, below snowbank, N. face of Mt. Pullen, ca. 450 to 500 feet (35103, 35103d). Damp, clay-shale, weathered slope at foot of Mt. Pullen (35104c, 35112, 35121a, 35133b). Damp, weakly basic moss-tundra heath, below persisting snowfield, The Dean (35156a, 35190a). Moist, peaty soil over basic, weathered slopes, late snow areas, Mt. Pullen (35301a, 35307c, 35307d, 35315a, 35348, 35352). Moist, thin humus, late snow area, with permafrost 1 to 2 inches from surface, The Dean, ca. 950 feet (35399). Small quantity on exposed, soil-covered scree slope, 2,000 to 2,400 feet, E. edge of U.S. Range, 9 to 10 miles due W. of Peak 1 (35615a). Damp, calcareous, loosely incorporated, steep snow-fed



scree slope, hills SW. of Mt. Pullen (35734, 35734a). Moist, exposed humus over snow-fed, calcareous, clay-shale slopes, SW. face of Mt. Pullen (35792, c. gyn.).

This distinctive new species, the only one in the genus with conspicuously spinose-dentate perichaetial bracts and subfloral leaves, has just been described (Schuster, 1958); it is, to date, known only from the Alert region, where, judging from the list of collections cited, it is occasionally but locally frequent.

### 19. *Tritomaria quinquedentata* (Huds.) Buch

Damp, moss-*Saxifraga* heath, snow-fed talus slope, foot of Mt. Pullen (35102, 35102a). In mats on moss-covered slope below large snowbank, N. face of Mt. Pullen (35103, 35103b). Damp, clay-shale slope, basic weathered slope, Mt. Pullen (35111a, 35112). Moist tundra heath, damp slope beneath persistent snowbank, The Dean (35188, 35160a, 35169). Damp, calcareous slope, Mt. Pullen (35180). In extensive spongy patches, moist, snow-fed, calcareous, weathered slopes, Mt. Pullen (35351, 35351a, 35344, 35348, 35345). Damp, peaty soil over basic, weathered, snow-fed slopes, Mt. Pullen (35307d, 35313a, 35317). Damp, peaty soil, snow-fed slope, highly calcareous E. face of Mt. Pullen (35337). Humus-covered, low scarp, at edge of persistent snowfield, ca. one-quarter mile N. of Mt. Pullen (35365). Moist, thin humus, late snow area (with permafrost 1 to 2 inches from surface), The Dean, ca. 950 feet (35399). In reddish-brown patches over snow-fed, damp, humus-covered slopes, weathered face of The Dean (35595). Exposed, damp humus, snow-fed scree slope, ca. 2,000 to 2,400 feet, E. edge of the U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35570a, 35574a, 35576a, 35579). Moist, humus-covered, calcareous clay-shale slope, below persistent snowbank, SW. side of Mt. Pullen, ca. 1,200 to 1,400 feet (35762a, 35792b).

This common arctic and subarctic plant is, if not calciphilous, at least tolerant of calcareous conditions. It has been known as far north as Low Point (lat. 83° 06' N.) and Cape Benet (lat. 83° 02' N.) on the north coast of Greenland, and I have seen several collections (erroneously reported by Bryhn, 1906, as the var. *turgida*) from central and southern Ellesmere Island; most of the reports of the species (and of the var. *turgida*) in Bryhn represent errors in determination for *Lophozia hatcheri* (Schuster, 1958). As is so common with species that penetrate into high arctic latitudes, distinctive modifications are produced. Regionally, the species usually has stoutly julaceous, although creeping shoots, with imbricate, scarcely fluted, concave and somewhat antically secund leaves; the stems are often very stout for the size of the plant. The most common modification, hence, is a mod. *parvifolia-densifolia-colorata*, "a compact sun form with bulging trigones and yellowish cell walls" (Schuster, 1958). Associated most often are *Anthelia juratzkana*, *Lophozia alpestris* var. *major*, *L. heterocolpa*, *L. quadriloba*, *Eremonotus minutus* var. *grandis*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Scapania polaris*, *Cephaloziella arctica*, *Plagiochila arctica*, *Solenostoma polaris*, *Odontoschisma macounii*, *Cryptocolea imbricata*, and *Tritomaria heterophylla*. Among associated mosses, under noncalcareous conditions, as on high scree slopes, are *Grimmia apocarpa*, *Racomitrium lanuginosum*, *Drepanocladus uncinatus*, *Dicranum fuscescens*, *Hylocomium splendens*, *Racomitrium canescens*, *Polytrichum*



*alpinum*, *Dicranum majus*, *Hypnum callichroum*, *Aulacomnium turgidum*, *A. palustre*, *Pohlia nutans*. The preceding mosses are associated chiefly under acid, or at least under less calcareous conditions; on decidedly calcareous, snow-fed slopes, the following mosses are frequently associated: *Fissidens arcticus*, *Timmia austriaca*, *Didymodon recurvirostris*, *Hypnum cupressiforme*, *Pohlia cruda*, *Bryum capillare*, *Holmgrenia chrysea*, *Ditrichum flexicaule*, *Didymodon recurvirostris*, *Philonotis fontana*, *Myurella julacea*, *Isopterygium pulchellum*, and *Mnium hymenophyllum*.

**19a. *Tritomaria quinquedentata* var. *grandiretis* Buch and Arnell in Arnell**

Moist, snow-fed scree slope, on humus, 2,000 to 2,400 feet, E. edge of U.S. Range, 9 to 10 miles W. of Peak 1 (35572a, 35593).

The plant occurred with typical *T. quinquedentata*, *Eremonotus minutus* var. *grandis*, *Lophozia quadriloba* var. *grandiretis*, *Scapania polaris*, and the mosses *Orthotrichum killiasii*, *Hypnum revolutum*, *Tetraplodon urceolatus*, *Timmia austriaca*, *Aulacomnium turgidum*, and *Pohlia cruda*.

Schuster (1958) shows that this plant possesses not only much larger leaf-cells than "typical" *T. quinquedentata*, but also more numerous oil-bodies per cell (see Fig. 3: 12 to 13 in Schuster, 1958, based on 35593). This station is the northernmost known for the variety, it having been reported previously only from Torne Lappmark, Sweden, and from northern Siberia. As is evident from Fig. 3:9, in Schuster (1958), the Ellesmere plant shows a sporadic tendency for the development of scattered marginal dentition; in this respect it approaches var. *dentata* S. Arn. (in Arnell, 1956), although not nearly as copiously toothed as is that variant.

**EREMONOTUS Kaalaas ex Pears., emend. Schuster**

(incl. *Sphenolobus* (Lindb.) Stephani; see Schuster, 1951a)

**20. *Eremonotus* (*Sphenolobus*) *minutus* (Cr.) Schuster, comb. n.**

*Jungermannia minuta* Cr., in Dicks., Pl. Crypt. Brit. Fasc. 2:13, 1790.

*Sphenolobus minutus* Steph., Spec. Hep. 2: 157, 1902.

Over moist, peaty humus, basic weathered slopes of Mt. Pullen (35301b, 35347). Over rather dry and exposed, weakly basic, strongly weathered slope of Mt. Pullen (35324, 35324a). Humus-covered, low scarp, at edge of persistent snowfield, ca. one-quarter mile N. of Mt. Pullen (35365). Snow-fed, well-drained, humus-covered scree slope, on The Dean, ca. 800 to 900 feet (35392a, 35397a, 35406, 35406a, 35412, c. per. andr.). In reddish-brown patches over snow-fed, damp, humus-covered slopes, weathered face of The Dean (35413, 35595). Dry, exposed, thinly humus-covered crest, weathered shale, 1,050 feet, on The Dean (35400, 35400a). Barely damp, exposed humus, over weathered steep rock slope, The Dean (35401, 35401a, 35401b). Damp, humus-covered, strongly weathered rock slopes, The Dean (35393, 35393a, 35393b). In shiny, reddish-brown patches on damp, scree slope, snow-fed, ca. 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35572b, 35570a, 35574a, 35579, 35579a). Among mosses in drainage grooves in loose, snow-moistened, exposed, scree-covered summit of hills,



ca. 3,000 feet, 9 to 11 miles due W. of Peak 1 (35593a). Moist, basic, weathered, springy slopes, S. side of Mt. Pullen on lower slopes (35313a). Over exposed, locally humus-covered scree, 2,000 to 2,400 feet, 8 to 10 miles W. of Peak 1, E. edge of U.S. Range (35614a).

*Eremonotus minutus*, commonly placed in the genus *Sphenolobus*, occurs in the Alert area only as the var. *grandis* (Lindb.) comb. n. (*Cephalozia rigida* var. *grandis* Lindberg, Bot. Not., 1965, 1872). The plants are erect, golden or chestnut-brown and sometimes somewhat reddish-brown tinged. They are often moderately glossy. The leaves are closely imbricate, hemispherically concave and somewhat cupped, appearing inflated, and average considerably broader than long; they are often somewhat complanate. Gemmae, in contrast to the "normal" forms of *E. minutus*, appear to be uniformly absent. The species is locally rare, occurring as a caespitose, rather reduced phase, scattered amidst the hepatics: *Lophozia ventricosa*, *L. floerkei hyperborea*, *L. excisa*, *L. groenlandica*, and *L. latifolia*, *Scapania polaris*, *Tritomaria quinquedentata*, *Gymnomitrium concinnatum*, *G. corallioides*, *Cephaloziella arctica*, *Anthelia juratzkana*, rarely *Plagiochila arctica*, and the mosses, *Dicranum majus*, *Timmia austriaca*, *Polytrichum alpinum*, *Hylocomium callichroum*, *Aulacomnium turgidum*. The plant occurred over stabilized, partially soil-covered scree slopes, under essentially noncalcareous conditions, more rarely on rocky, clayey soil under weakly calcareous conditions. Perhaps most typical is the occurrence in seepage-damp, moss-filled, drainage crevices, below permanent snowfields, under essentially noncalcareous conditions. Associated under such conditions were *Orthotrichum killiasii*, *Hypnum revolutum*, *Tetraplodon urceolatus*, *Timmia austriaca*, *Aulacomnium turgidum*, and *Pohlia cruda*. *E. minutus* also occurred under xeric conditions, on relatively loose scree, associated with the *Gymnomitria*, such mosses as *Rhacomitrium lanuginosum*, *Hylocomium splendens*, *Aulacomnium turgidum*, *Timmia austriaca*, *Hypnum callichroum*, *Dicranella crispa*, *Bartramia ithyphylla*, and *Polytrichum alpinum*.

## SCAPANIACEAE

### SCAPANIA Dumort.

#### 21. *Scapania lapponica* (Arn. & Jens.) Steph.

Moist, soil-filled crevices of vertically bedded, contorted, noncalcareous slates, deep ravine near S. end of Hilgard Bay, lat. 86° 26' N., long. 63° 18' W. (35911a, 35477). In small, purplish-black patches, damp rocks at edge of ravine, near S. end of Hilgard Bay, lat. 82° 27' N., long. 63° 10' W. (35226).

The present plant belongs to the subgenus *Jensenia*, segregated recently by Arnell (1956). Dr. Arnell, who has studied my material, believes the American plant is not quite identical with *S. lapponica*, and it may prove necessary to segregate it as a new species.<sup>1</sup> However, since *S. lapponica* is still so poorly known, from a few localities in northern Sweden and Norway, I prefer to refer the Ellesmere material to this until the variability

<sup>1</sup>Arnell (in litt.) has expressed the opinion that the Ellesmere plants are probably "not identical. *S. lapponica* has much larger cells, but the general appearance is much the same." The cell size in the Ellesmere plants averages about the same "as in *S. obcordata* (Berggr.) from Spitsbergen, and young shoots are almost impossible to distinguish, but more adult shoots have a different shape of the leaves. . . at least I think so."



of the species is better ascertained. In any case, the present collections mark the first of the subgenus *Jensenia* from North America, and represent a major northward extension of it. Arnell (in litt.) has pointed out to me that the plant described by Berggren, from Spitsbergen, as *Sarcoscyphus obcordatus*, is a second species assignable to *Jensenia*.

It is of interest that the plants of this species, collected from two nearly adjacent small ravines, occurred with *Mielichhoferia mielichhoferiana*, *Grimmia alpestris*, and *Hygrohypnum alpestre*, three rare and local species, found only at these localities. Also associated were plants of a large-celled *Cephaloziella* which I believe are conspecific with *C. grimsulana*, otherwise not known with certainty from North America. The plants of 35911a were associated with *Gymnomitrium corallioides*, *Grimmia apocarpa*, *G. alpestris*, *Ditrichum flexicaule*, *Encalypta alpina*, *Tortula ruralis*, *Didymodon rufus*, *Hypnum cupressiforme*, and the *Mielichhoferia*. The *Scapania* formed small, purplish-black patches, with the individual plants strongly violet or violet-purple; the plants were abundantly gemmiparous, with the gemmae 2-celled, mostly greenish, but a few purplish or vineous.

## 22. *Scapania cuspiduligera* (Nees) K. Müll.

Clay slopes on Dumbbell Bay, at Alert (35059). Traces in damp tundra, over calcareous clay-shale slope, between Dumbbell Bay and The Dean (35064). Moist clay polygon soil, low level polygon field, highly calcareous locally (35070).

The present collections represent the northernmost yet made of this species; it was reported by Bryhn (1906) from southern and central Ellesmere Island. In the high Arctic the species may occur as a highly derivative phase, in sites differing greatly from those normally frequented by the species. The few traces of the species found locally occur in places where they are covered by snow for nine to ten months of the year, but during the other two to three months are exposed to constant and intense sunlight. Except during the spring run-off, they occur on dry, baked, calcareous clay slopes, receiving on an average less than 0.2 to 0.5 inch of rainfall during the growing season. However, during the spring run-off, the site is saturated by water, or actually covered by it for short intervals. A less favourable site for growth can hardly be imagined! The plants here occur as black, dense-leaved phases, together with analogous phases of *Cephaloziella arctica* and *Solenostoma polaris*; associated are such angiosperms as *Salix arctica*, *Papaver radicum*, *Festuca baffinensis*, *F. brachyphylla*, *Saxifraga oppositifolia*, *Cerastium regelii*, and *Draba* spp.

The local plants of *S. cuspiduligera* belong to a highly xeromorphic, extreme arctic phase which is at first glance scarcely recognizable. The plants of 35059, *p.p.* are a case in point. These are up to 1.5 mm wide  $\times$  4 to 6 mm long (with the extremely fleshy stems 350 to 380  $\mu$  wide!), but are usually smaller; they possess quite unequally bilobed leaves, with the antical lobe from 0.5 to 0.7 the size of the postical, although usually squarrose, as in typical phases; the lobes, even on nongemmiparous leaves are commonly apiculate and may bear vestiges of teeth subapically (owing to irregularly protuberant marginal cells). More marked than this is the extremely dense and closely imbricate disposition of the leaves, the blackish pigmentation of all but the basal portions of the leaves, the virtual lack of



a distinct border of thick-walled leaf-cells; the plants are in general a mod. *densifolia-parvifolia-colorata* bearing the unusually fleshy stems characteristic of many high arctic extremes of otherwise slender-stemmed species. At first glance a disposition of these plants as *S. cuspiduligera* would strike one as absurd, yet the plants have the five critical features distinguishing this species: (a) mature leaves distinctly decurrent postically to below the keelar insertion; (b) brownish, very large oil-bodies, usually (1) 2 to 4, occasionally 5 to 6 per cell and almost filling the cell-lumen; (c) narrow and sub-entire or entire leaf-lobes; (d) brownish, 2-celled gemmae; (e) on the occasional mature plants seen, leaf-bases distinctly sheathing.

Such arctic phases of *S. cuspiduligera* are subject to confusion with both *S. gymnostomophila* and *S. calcicola* var. *ligulifolia*. The presence of 2 to 4 oil-bodies in most cells at once eliminates the former; the distinctly decurrent postical leaf-bases, running down to well below the insertion of the keel, serve to eliminate both of these species from confusion. In spite of this, the plants superficially can be mistaken for one or both of these latter species, since the smaller, juvenile plants have the antical lobes merely half the size of the postical, but distinctly squarrose, giving them a facies strongly suggestive of the latter taxa. The distinctness of these smaller plants from *S. gymnostomophila* is quite apparent from the fact that in 35064, in which traces of both *S. cuspiduligera* and *S. gymnostomophila* occur, the two are readily distinct—*S. gymnostomophila* possessing non-decurrent leaves and solitary brownish oil-bodies in the cells. The deep reddish-brown gemmae of such plants serve to separate them from *S. polaris*, a plant at times superficially very similar.

### 23. *Scapania gymnostomophila* Kaalaas

Among mosses, damp crevices of soil polygons, calcareous clay-shale slope, Alert (35067b). Moist, clay-shale slope along ravine, 2 miles S. of Alert (35050, 35050e). Damp, clay-shale slope, fed by snowbank, Dumbbell Bay (35082). Over damp, calcareous humus, on basic, weathered slope at foot of Mt. Pullen (35133a). Damp, calcareous clay-shale solifluction slope, head of Parr Inlet (35144, 35148, 35150). Damp, mossy, basic slope, below persisting snowbank, The Dean (35175, 35158, 35185). Damp humus, calcareous slope, over damp rocks, edge of small ravine, S. end of Hilgard Bay (35229, 35241a, 35246a). Damp, calcareous slope, Cape Belknap, edge of Dumbbell Bay (35281b). Over damp, weakly basic, exposed, steep, weathered slope, below persistent snowbank, Mt. Pullen (35332, 35336, 35341, 35343a). Damp humus, over calcareous clay-shale, low scarp, edge of persistent snow-ice-field (35368, 35373). Moist, shallow humus layer, frozen to within 1 to 3 inches of surface, edge of persistent snow-ice-field, one-quarter mile N. of Mt. Pullen (35362). Among mosses on dripping, damp rocks, small ravine at S. side of Hilgard Bay (35486). Damp, steep, weathered clay-shale slopes, valley between Peak 1 and Peak 2, ca. 850 to 950 feet, 5 miles SW. of end of Hilgard Bay (35550). Damp, snow-fed, steep basic slope, ca. 1,800 to 2,400 feet, E. edge of U.S. Range, 9 to 10 miles due W. of Peak 1 (35571, 35600, 35599, 35599a). Moist, moss-covered, calcareous clay-shale slope, edge of frozen Lincoln Sea, polar ice-cap, 1.5 to 2 miles W. of Cape Belknap (35752). Among mosses, on loosely incorporated scree, SW. end of Mt. Pullen (35724). Damp, exposed, thin humus over calcareous clay-shale slope, S. end of Hilgard Bay (35932e).



*S. gymnostomophila* is the most common species of the genus in the calcareous lowlands of northeastern Ellesmere Island. It, however, usually occurs scattered, often as isolated plants, and very rarely is found in any quantity. It usually occurs amidst a series of mosses, and appears to be among the hardiest of the regional bryophytes, occurring exposed as early as June 3, before the snow-melt period was well underway; it is then found on clay-shale slopes, together with *Blepharostoma trichophyllum* ssp. *brevirete* and *Solenostoma polaris*—a combination of species often associated under conditions where other hepatics fail to undergo ecesis. Under such conditions, a series of weedy, tolerant mosses are associated, chief among them: *Hypnum revolutum*, *Tortula ruralis*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Barbula icmadophila*, *Timmia austriaca*, *Mnium hymenophyllum*, *Anoetangium tenuinerve*, *Philonotis fontana*, etc. The species is widespread under a variety of conditions, as long as the substrate is calcareous; it is perhaps commonest on basic slopes, often on solifluction slopes, where hanging snowbanks result in permanent irrigation during the growing season; under such conditions, as on the NW. side of The Dean (35167, 35167a), a large variety of other hepatics may be associated, among them *Cephaloziella arctica*, *Lophozia alpestris major*, *L. quadriloba*, *L. pellucida*, *Solenostoma polaris*, and numerous mosses, among them *Drepanocladus revolvens*, *Philonotis fontana*, *Pohlia cruda*, *Ditrichum flexicaule*, *Myurella julacea*, *Distichium capillaceum*, *Polytrichum alpinum*, *Barbula icmadophila*, *Tortula ruralis*, *Timmia norvegica*, *Dichodontium pellucidum*, *Bryobrittonia pellucida*, *Didymodon recurvirostris*, *Cinclidium arcticum*, *Timmia austriaca*, *Amblystegiella sprucei*, *Anoetangium tenuinerve*, *Holmgrenia chrysea*, *Encalypta alpina*, and *Mnium hymenophyllum*. In addition to the preceding hepatics, a wide variety of others are occasionally associated, among them *Lophozia excisa*, *Scapania polaris*, *Plagiochila arctica*, *Cephaloziella arctica*, *Arnellia fennica*, *Preissia quadrata*, *Sauteria alpina*, *Athalamia hyalina*, *Trichostylium pinguis*, *Tritomaria quinquedentata*, *T. heterophylla*, *Lophozia muelleri*, *L. heterocolpa*, and *Cryptocolea imbricata*. In addition to a series of characteristic occurrences on strongly calcareous sites, the species also is found on the sides of damp, shaded, noncalcareous shale and sandstone ledges, together with such unusual associates (in 35476–35486) as *Scapania lapponica*, *Cephaloziella grimsulana*, *Hygrohypnum alpestre*, *Timmia norvegica*, *Mielichhoferia mielichhoferiana*, *Grimmia alpestris*, *Polytrichum piliferum*, and *Tortula mucronifolia*.

The species has been collected previously at Wrangel Bay, Grant Land (Wolf ex Bryhn, 1908; a fragment in the New York Botanical Garden), and widely reported from central and southern Ellesmere Island (Bryhn, 1906), both under the names *Diplophyllum gymnostomophilum* and *D. incurvum*. The status of the latter plant is questionable. Frye & Clark (loc. cit.) retain it as a distinct species, while Persson has considered it to be a synonym of *S. gymnostomophila*. I have made a special study of the *S. gymnostomophila* complex in Ellesmere I. and must agree with Persson that a reduced, blackish sun form is at hand. The key of Frye & Clark (loc. cit., p. 569) contradicts their diagnosis (p. 580) in many respects, and the attempt at a separation in their key appears invalid. They, i.e., describe the leaf as 1.8 to 2.4 mm long (p. 569), while on page 580 the entire shoot is stated to be only 1.5 to 2.25 mm wide. The supposed differences in orientation of the ventral lobes are inconstant—in *S. incurva*



the ventral lobe is described as ascending, with incurved margins. This condition can also be met with in *S. gymnostomophila*. If *S. incurva* is to be recognized at all, it can be admitted merely as a forma, separable chiefly by the italicized characters in the following diagnosis prepared from living plants (35050, etc.):

SCAPANIA GYMNSTOMOPHILA fo. INCURVA (Bryhn & Kaalaas ex Bryhn) comb. n. *Diplophyllum incurvum* Bryhn & Kaalaas, in Bryhn, Rept. 2nd Norwegian Arctic Exped. in the "*Fram*," No. 11: 48, 1906.

Plants green to blackish-green, similar in aspect to *S. calcicola* var. *ligulifolia*. Stems thick and fleshy. Leaves somewhat antically secund, loosely folded, the concave ventral lobe as in typical *S. gymnostomophila*, the often slightly concave dorsal lobe often slightly squarrose, erect to obliquely spreading. Ventral lobe ovate-oblong, hardly falcate, ca. 800 to 850  $\mu$  long  $\times$  620  $\mu$  wide, width usually 0.72 to 0.80 the length, widest at or below the middle, apiculate (often with a mucro formed of 2 superimposed cells). Dorsal lobe (1/3) 2/5–1/2 the ventral in size, usually somewhat concave, and at least with apical portion standing away from stem (and ventral lobe), often somewhat squarrose, 550 to 580  $\mu$  long  $\times$  320 to 370  $\mu$  wide, usually 0.57 to 0.65 as wide as long, ovate and suddenly pointed like ventral lobe, rather suddenly narrowed to base and distinctly ampliate above it, widest at this sub-basal point. Cells in marginal 1 to 3 rows somewhat thick-walled, elsewhere thin-walled and with distinct but hardly bulging trigones; marginal cells ca. 11 to 15  $\mu$ , sometimes somewhat thick-walled; in leaf-apices within margins 14 to 17  $\times$  15 to 19  $\mu$ , in leaf-middle 18 to 20 (23)  $\times$  22 to 25  $\mu$ . Oil-bodies 1 or less commonly 2 per cell, brownish, very large, obscuring most of cell-lumen, 6 to 8  $\times$  8 to 10  $\mu$  up to 12  $\times$  16  $\mu$ . A basal large area, gradually broadening from the middle of postical margin, involving entire leaf-base, hyaline, the cells devoid of chloroplasts or oil-bodies, somewhat thick-walled; a much smaller area of antical leaf-base similarly devoid of oil-bodies and chloroplasts. Gemmae restricted to apices of lobes, reddish-brown, 2-celled, mostly 15  $\times$  22 to 26 to 16  $\times$  24 to 28 (34)  $\mu$ .

TYPE. Ellesmere Island (Simmons).

DISTRIBUTION. General in Ellesmere Island, and as far as South Kent Island, evidently a high arctic phase of the species, ranging north to above lat. 82°30', thus one of the most rigidly arctic taxa among the Hepaticae.

*S. gymnostomophila* fo. *incurva* is possibly only a phase of *S. gymnostomophila* (according to H. Persson). However, the preceding description, drawn from living plants, suggests that minor genotypic differences occur. The plants look somewhat different, owing to the less distinctly falcate ventral lobes, the often somewhat squarrose and concave dorsal lobes, which may stand stiffly away from the stem, and the somewhat larger size of the dorsal lobes, which are furthermore somewhat dilated above the sharply constricted postical base. In all of these features, as well as in the tendency toward formation of a slightly thick-walled border of marginal cells, the var. *incurva* closely approaches *S. polaris*. *S. polaris* appears to



differ from *S. gymnostomophila* fo. *incurva* chiefly in three respects, as regards sterile plant: (a) the dorsal lobes are somewhat larger, averaging between one-half and two-thirds the area of the ventral lobes; (b) the cells have (2) 3 to 5 (6) oil-bodies each, rather than 1 or occasionally 2; (c) ventral lobes which have not produced gemmae are often rounded at the apex, rather than apiculate.

#### 24. *Scapania polaris* Schuster

Damp, weakly basic shale clay slope at foot of Mt. Pullen (35101c, 35103f, 35106). Damp, thin humus over basic weathered slope of Mt. Pullen (35108, c. per.; 35192a). Among mosses, intermittently damp, snow-fed slope, Mt. Pullen (35121, 35124). Moist, basic moss-heath below persisting snowfield, The Dean (35181, 35181a, 35183, 35190, 35190a). Moist humus, among mosses and *T. quinquedentata*, base of The Dean (35156c, 35159, c. gem.). Over damp, basic slope, below persisting snowfield, The Dean (35177a). Basic, moist, snow-fed slopes of Mt. Pullen (35341, 35343a, 35353b). Moist, shallow humus layer, frozen to within 1 to 3 inches of surface, at edge of persistent snowfield, scarp one-quarter mile N. of Mt. Pullen (35362). Damp, clay-shale soil, edge of low scarp at edge of persistent snow-ice-field, one-quarter mile N. of Mt. Pullen (35368b). Exposed, dry humus, over low, calcareous scarp, edge of persistent snow-ice-field, one-quarter mile N. of Mt. Pullen (35373, 35375). Scattered in moss-*Gymnomitrium* mat, exposed soil near summit of The Dean, ca. 1,050 feet (35391a). Barely damp, humus-covered, greatly weathered slopes of The Dean, ca. 750 to 800 feet (35401c). Exposed, damp humus, steep, snow-fed scree slope, 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35570a, 35572c, 35574b, 35595, 35615b, 35616). Damp, calcareous, loosely incorporated, steep, snow-fed scree slope, hill SW. of Mt. Pullen (35734, 35734a, 35735 [=35706]). In large greenish patches among *Polytrichum*, on steep, damp, weakly calcareous, exposed SW. slope of Mt. Pullen (35782, 35782e). Moist, calcareous clay-shale slope, SW. side of Mt. Pullen, 800 to 1,400 feet (35762, 35783a). Among mosses, on loosely incorporated scree slope, SW. end of Mt. Pullen (35724, 35767).

This recently described species of *Scapania* (Schuster, 1959a) bears very close affinities to both *S. mucronata* and *S. calcicola*, particularly to the var. *ligulifolia* Schuster, known only from the Hudson Bay area (Schuster, 1951). To date, *S. polaris* is known only from the Alert region, where, however, it is not frequent. The species is a definite calciphyte; in the Alert area it is usually found over bare humus, or straggling among mosses, over loose calcareous talus, calcareous weathered shale slopes, and talus-clay solifluction slopes. Associated are *Lophozia quadriloba*, *L. heterocolpa*, *L. alpestris* var. *major*, rarely *L. excisa*, *Plagiochila arctica*, *Arnellia fennica*, *Tritomaria heterophylla*, *T. quinquedentata*, *Cephaloziella arctica*, and *Anthelia juratzkana* (at Mt. Pullen). The associates are all either tolerant of calcareous conditions or decided calciphytes. On The Dean, there are associated most of the same species, as well as *Cryptocolea imbricata*, *Odontoschisma macounii*, and *Gymnomitrium concinnatum*. The associated mosses



are, i.e., *Fissidens arcticus*, *Timmia austriaca*, *Didymodon recurvirostris*, *Hypnum cupressiforme*, *H. revolutum*, *Pohlia cruda*, *Bryum capillare*, *Barbula icmadophila*, *Isopterygium pulchellum*, *Tetraplodon urceolatus*, *Polytrichum alpinum*, *Holmgrenia chrysea*, *H. stricta*, *Tortula ruralis*, *Encalypta alpina*, *Philonotis fontana*, *Ditrichum flexicaule*, *Myurella tenerima*, *Drepanocladus uncinatus*, rarely *Dicranella crispa* and *Bartramia ithyphylla*. Under unusually exposed conditions as on scree, where associated with such pioneers as *Gymnomitrium corallioides*, the mosses *Rhacomitrium canescens*, *Orthotrichum killiasii*, *Hypnum revolutum*, *Pohlia cruda*, *Isopterygium pulchellum*, *Polytrichum alpinum*, *Philonotis fontana*, *Anoetangium tenuinerve*, *Barbula icmadophila*, and *Myurella tenerrima* may be associated.

*S. polaris* is a rather variable species, characterized by the evident tendency for the gemmae to develop yellowish to yellowish-brown secondary pigmentation; by the large oil-bodies, occurring (2) 3 to 5, occasionally 6 per cell; by the large dorsal lobe, usually 0.6 to 0.75 the ventral in size; by the inability of the leaves or stem to develop strong secondary pigmentation, the stem remaining greenish to yellowish-brown in sun forms; and by the ciliate perianth-mouth. Perhaps most characteristic is the fact that the gemmae and leaf-lobes react similarly to sunlight: both develop a yellow-brown pigmentation. Similar reaction-patterns are absent in our other species of the Sectio Curtae. The typical form of *S. polaris* shares with nearctic phases of *S. mucronata* the unbordered leaves (marginal cells, except near postical base, collenchymatous like the inner cells); the obscurely apiculate ventral lobes; a generally yellow-green to pale brown colour, with the gemmae often barely pigmented; the usual presence of 3 to 5 large oil-bodies in the cells of the lobes. In the separation of the species from *S. mucronata*, particular attention must be paid to (a) the distinctly larger gemmae, their walls, when mature, always at least a pale golden yellow in colour; (b) the generally somewhat larger oil-bodies; (c) the presence, on robust plants, of isolated and scattered small teeth of the apices of postical and antical lobes; (d) the apparent inability to develop coarsely bulging trigones; (e) the very different perianth-mouth.

In the very large oil-bodies and gemmae, whose walls are somewhat brownish or golden, *S. polaris* also approaches the arctic *S. arnellii*. The latter, however, has 1-celled and very small gemmae; a subentire perianth mouth, and entire leaf-lobes.

The perianth mouth of *S. polaris* is distinctive. It is armed with contiguous cilia or slender teeth, usually (3) 4 to 5 cells long and 1 to 2 cells wide at the very base. In the closely and quite regularly ciliate perianth mouth the species differs from all others in the Sectio Curtae, approaching only *S. microphylla*. The frequent production of perianths in *S. polaris*, together with the gemma size, serves to separate that species from *S. calcicola*, a plant known only in the sterile condition. However, in both *S. polaris* and in typical *S. calcicola* the leaf-lobes, at least distally, tend to be armed with a few scattered, sharp teeth; in this character *S. polaris* also recalls *S. microphylla*.



## JUNGERMANNIACEAE

## SOLENOSTOMA Mitt.

25. *Solenostoma polaris* (Berggr.) Schuster, comb. n.

*Jungermannia pumila* var. *polaris* Berggren, K. Svensk. Vetensk.-Akad. Handl. 13(7): 98, 1875.

*Jungermannia polaris* Lindb., Ofvers. af K. Svensk. Akad. Förhandl. 23: 560, 1867.

? *Aplozia polaris* Bryhn, Rept. 2nd Norwegian Arctic Exped. in the "Fram" 11: 29, 1906.

*Aplozia schiffneri* Loitlesberger, Verh. Zool.-Bot. Gesell. Wien 55: 482, 1905 (new synonymy).

*Solenostoma schiffneri* Schuster, Amer. Midl. Nat. 49(2): 405, 1953 (new synonymy).

Over damp clay, heaved, calcareous, early uncovered by snow, Alert (35051). Moist calcareous polygon soil, edge of temporary pond, between Alert Weather Station and Dumbbell Lake (35063). Traces, among mosses, damp crevices of soil-polygons, calcareous clay-shale slope, Alert (35067a). Moist, calcareous polygon soil, shallow polygon field, edge of shallow pond between Parr Inlet and Upper Dumbbell Bay (35072, c. per.). Wet, calcareous clay-shale solifluction slope, head of Parr Inlet (35142, 35142a, 35150). Among *Drepanocladus* and other mosses on a basic solifluction slope, shallow gorge below snowbank, NW. side of The Dean (35167). Moist, calcareous clay-shale slope beneath persistent snowbank, 2.5 miles W. of Cape Belknap, S. of Williams Island (35201). Damp, calcareous slopes, S. end of Hilgard Bay (35225b, 35235b, 35238a, 35243, 35246, c. caps., 35248). Damp rocks, small ravine cut into head of Hilgard Bay (35229). Moist, calcareous clay slope, Cape Belknap, edge of Dumbbell Bay (35281b, 35295, 35296, 35296a). Exposed, thin, peaty humus over basic, snow-fed, weathered slope, Mt. Pullen (35352). In olive-green patches on damp, calcareous clay, head of Parr Inlet (35473a). Damp, calcareous, humus-covered clay-stone slope, S. end of Hilgard Bay (35929). Old musk-ox dung, wet polygon field, highly calcareous, near edge of "Lake Anxiety," SE. side of Hilgard Bay (35936).

This taxon, usually occurring as scattered plants and rarely forming distinct patches, is widespread in the Alert area on both calcareous and noncalcareous substrates, although apparently much commoner on the former. Müller (1951-58, p. 813) incorrectly states it is confined to "kalkfreier Unterlage." The plant, or at least a plant determined as *Aplozia polaris*, was reported from central and southern Ellesmere Island by Bryhn (1906); it was originally described from Spitsbergen. The species was considered by Steere (1937) as a "Cordilleran species," although it is known from British Columbia and doubtfully from Alberta, eastward to Minnesota (Schuster, 1953), Michigan, and Wisconsin, and to Quebec (Lepage, 1945). The latter reports are all under the synonymous names *Jungermannia schiffneri* or *Solenostoma schiffneri*. There is also an old and dubious report from Greenland, based on Lindberg, as *Jungermannia polaris*. The species is widespread in Europe and occurs on Jan Mayen Island.



In the high tundra of northern Ellesmere the plant is widespread on snow-fed, damp tundra slopes, on calcareous, clayey talus slopes and elsewhere, together with *Arnellia fennica*, *Cephaloziella arctica*, *Scapania gymnostomophila*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Athalamia hyalina*, *Lophozia muelleri*, *L. gillmani*, *L. heterocolpa*, *L. quadriloba*, *L. alpestris major*, *L. pellucida*, *Sauteria alpina*, *Trichostylium pinguis*, *Cryptocolea imbricata*, and *Preissia quadrata*. It also occurs, less commonly, in the damp crevices of low-lying polygon fields, and on clay-shale solifluction slopes associated with some of the previous species as well as *Lophozia badensis*, *L. hyperarctica*, and *Scapania polaris*. Commonly associated mosses are *Hypnum revolutum*, *Tortula ruralis*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Barbula icmadophila*, *Timmia austriaca*, *Philonotis fontana*, *Mnium hymenophyllum*, *Anoetangium tenuinerve*, less often *Drepanocladus revolvens*, *Pohlia cruda*, *Myurella julacea*, *Polytrichum alpinum*, *Timmia norvegica*, *Dichodontium pellucidum*, *Bryobrittonia pellucida*, and *Didymodon recurvirostris*. The plant usually occurs in small quantity, forming olive-green to greenish-brown or blackish, loose patches, or, often, straggling individually among mosses. Unlike most other hepatics of the area, it is almost always fertile, although the determination of a parœcious inflorescence is often difficult.

*Solenostoma polaris* is a "critical" species. Its separation from *S. pumilum* and *S. atrovirens* is often very difficult to accomplish in arctic materials, and I wonder to what extent the reports by Bryhn (1906) of this complex need revision. For example, in plants of *Schuster 35731* (SW. of Mt. Pullen, Ellesmere Island) it is almost impossible to state to which of two "species" the material should be relegated. In these plants the perianths are narrowed from near the middle to the apex, into a distinctly conical apex, and the leaves of the most robust plants may have the marginal cells as high as 21 to 23  $\mu$ , the median cells 21 to 24  $\times$  23 to 28  $\mu$ . In these two respects the plants closely approach *S. pumilum*. Yet, in the broadly ovate to subrotund leaf-shape, in the cells of the less robust plants (there 17 to 18  $\mu$  on the margins; 14 to 18  $\times$  16 to 23  $\mu$  medially); and in the occasional perianths which remain subequally broad to within the distal one-fourth, in which they are obscurely conically narrowed, many of the plants of this collection clearly approach *S. polaris*, approaching the following var. *cavifolius* in extreme instances. The sexuality of these plants, like those of other high arctic phases of the complex, is variable. Almost all plants are parœcious, but occasionally perianth-bearing shoots have a single perichaetial bract with one antheridium, all subtending leaves being sterile, and in few cases the gynœcial shoots lack antheridia below. In isolated instances of this type, long, distinctly spicate antheridial branches could be demonstrated, in one case with 12 to 14 pairs of saccate bracts. Although the plants of this collection (and of several similar collections) are referred to *S. pumilum*, this is done chiefly because the few capsules show clearly the characters of this last species. Therefore, without capsules, the certain identification of some phases of this complex remains problematical.



In the Arctic, *S. polaris* and *S. atrovirens* are sometimes equally difficult to distinguish, if the inflorescences (parœcious and diœcious, respectively) cannot be ascertained. The highly modified arctic phases of these two species often are scarcely typical. *S. atrovirens* usually is separable on the basis of the larger leaf-cells. In *S. polaris* much of the material seen (e.g. Ellesmere Island, *Schuster 35051*) had slender, sterile shoots, only 450 to 600  $\mu$  wide, with distant, suberect, concave, reduced, and broad leaves. The leaves, in such cases, were broadly rotundate, attached by a very broad line of insertion, and failed to show the ovate or ovate-cordate leaf shape usually assigned to the species. Only when unusually robust plants and fertile plants were studied was it possible to demonstrate leaves of the usually broadly ovate form. In the case of such arctic extremes, a clear-cut determination probably will have to depend on a definite determination of the sexuality of the plant.

Unfortunately, in the high Arctic, *S. polaris* is also frequently somewhat variable as to sexuality. I have seen in a number of collections individual plants where the gynœcia were not subtended by male bracts, and the plants gave every evidence of being diœcious. In other cases, isolated plants were seen where the gynœcia were on rather short lateral branches, again without antheridia in the axils of the leaves below them, but the same plant bore an andrœcial branch, compactly spicate, formed of 4 to 6 or more pairs of bracts. Such autœcious plants are very rarely produced. From this high level of variability in development and location of antheridial bracts, it follows that the determination of a parœcious inflorescence in this species at times entails dissection of several young inflorescences.

The variability in sexuality, although considerable, never ranges to the predominantly diœcious. The sporadically autœcious (and rarely diœcious) plants found could easily cause confusion with the otherwise exceedingly similar *S. atrovirens*. In this conjunction "*Haplozia polaris*" (*Jungermannia pumila* var. *polaris* Berggren; *J. polaris* Lindb.) must be considered. This "species," known from Greenland and Spitsbergen and reported from numerous stations in Ellesmere Island (Bryhn, 1906, p. 29), is considered a synonym of *Jungermannia* (or *Solenostoma*) *atrovirens* by both Stephani (1902, p. 519, in 1900-24) and Müller (1909, p. 567, in 1905-16). The interpretation of Stephani and Müller, however, is wrong, as the plants which I have seen are parœcious. I found no material safely referred to *S. atrovirens* in the abundant examinations made in northern Ellesmere Island, but found the largely or entirely parœcious *S. "schiffneri"* very common. Yet Bryhn (1906) found *S. polaris* and *S. atrovirens* to be common in central and southern Ellesmere—but did not report the then recently described *S. schiffneri*. It must also be noted that Berggren (1875) considered his plant to be a mere variety of the parœcious *S. pumilum*, the implication being that *S. polaris* thus was also parœcious. Part of the confusion may have resulted from the fact that in *S. "schiffneri"* shoots with mature perianths usually fail to show antheridia in the subfloral leaves, these having disintegrated. However, plants with immature perianths (at and just beyond fertilization) are almost always to be found and usually



show the antheridia, or remnants of them, in the subfloral leaves. If the antheridia are overlooked, *S. "schiffneri"* is quite likely to be considered to be dioecious, and mistaken for *S. atrovirens*.<sup>1</sup>

Some of the high arctic phases of *S. polaris* not only differ in the variability of the inflorescences, but also show important differences in leaf-shape, probably warranting separation as a distinct entity, as follows:

### 25a. *Solenostoma polaris* fo. *cavifolius* fo. n.<sup>2</sup>

Plants creeping to erect, usually scattered amidst caespitose mosses, green to fuscous-brown, small (shoots from 450 to 650  $\mu$  to 900  $\mu$  wide  $\times$  5 to 8 (12) mm long). Stems flexuous, 150 to 190 (210)  $\mu$  in diameter, ca. 10 to 12 cells high, green to (with age) brownish, fleshy, unbranched or with rare lateral branches; cortical cells thin-walled or weakly thick-walled, rectangular, 16 to 21 (23 to 25)  $\mu$  wide  $\times$  (32) 45 to 72 (80)  $\mu$  long dorsally and laterally, 14 to 16  $\mu$  wide ventrally, scarcely differing in diameter from medullary cells (smaller in ventral 2 to 4 strata, ca. 10 to 15  $\mu$ , the dorsal 16 to 23  $\mu$  in diameter up to 20 to 25  $\mu$  in diameter); peripheral 2 to 3 (4) strata of medullary cells on ventral and lateral sides of stem becoming mycorrhizal with age, brownish, partly destroyed, the cortical cells relatively slightly infected. Leaves contiguous to closely *imbricate*, *suberect to erect and slightly antically secund*, *moderately to strongly and sometimes almost hemispherically concave*, *broadly rotundate* and averaging slightly broader to greatly broader than long (ca. 350 to 375  $\mu$  long  $\times$  440 to 460  $\mu$  wide, but often smaller, up to 525 to 560  $\mu$  long  $\times$  600 to 725  $\mu$  wide), entire-margined; insertion at ca. a 45 degree angle, the antical and postical bases of the leaves scarcely or short-decurrent. Rhizoids in a brownish fascicle from a swollen area at base of postical leaf-insertion, *few or virtually absent elsewhere*, 9 to 10  $\mu$  in diameter. Cells rounded-polygonal, averaging isodiametric on the margins distally, and slightly elongated at and below leaf-middle, with smooth cuticle and *small to large but concave to straight-sided trigones* (rarely faintly bulging); *marginal cells* 13 to 17  $\mu$ , rarely averaging 12 or 18 to 20  $\mu$  for short distances; *median cells* (12) 14 to 16 (17 to 18)  $\mu$  wide  $\times$  16 to 19  $\mu$  long, ca. 16  $\mu$  in thickness, the basal cells slightly larger; *oil-bodies very large*, 2 to 3 (4) *per cell*, short ovoid or ellipsoidal, from 4  $\times$  6 to 4.5  $\times$  9  $\mu$  up to 6  $\times$  7.5 to 10  $\mu$ , a few spherical and 4 to 5  $\mu$ , *appearing almost homogeneous* (but under oil-immersion evidently formed of minute, scarcely perceptible spherules); chloroplasts much smaller, ca. 3.5  $\mu$  long.

<sup>1</sup>Since typesetting of manuscript I have seen a fragment of the type of *J. polaris* (Spitsbergen, May 8, 1867, leg. Malmgren), sent by Dr. S. Arnell, who writes, "Without doubt, . . . dioecious, with separate male plants; it seems also to have been the opinion of Lindberg." The single perianth-bearing plant I saw was carefully dissected, and I believe I was able to find the base of the stalk of an antheridium in the axil of a ♀ bract; hence the type is presumably partly paro-, partly auto- and partly dioecious, as are my Ellesmere collections. If study of the remainder of the type will confirm these observations, synonymizing *S. schiffneri* as here proposed can be regarded as justified. In vegetative features, the type plants exactly match the material assigned to *S. polaris*, in part approaching fo. *cavifolius* in the orbicular concave leaves, although the leaves are more remote. Furthermore, *J. pumila* var. *polaris* Berggr., from Sommebay, Spitsbergen (Berggren 176, 1868; Musci Spitzberg, exs. No. 176), which deserves to be considered typical of var. *polaris*—if not of the species *polaris*—is identical in all respects with the Ellesmere plants. These plants are definitely paroecious; they have the capsule-wall as in *J. schiffneri*: median epidermal cells with 2 to 4 strong nodular thickenings of each face of alternating longitudinal walls; walls alternating with those bearing strong thickenings lacking them, or sporadically with 1 to 2; cells averaging 13 to 15  $\mu$  wide. Perianths occasionally are somewhat conoidally narrowed in the distal third, as in many of the Ellesmere plants.

Müller (1905-1910, p. 566) incorrectly states the type of *S. polaris* is from Greenland.

<sup>2</sup>Folia imbricata, antice secunda, concava, late orbiculata, generaliter 1.1-1.3 latiora quam longa, late jugata ad caulem; plantae paroecae vel isolatae plantae autoecae vel dioecae. Typus: The Dean, Alert, Ellesmere I. (35408).



*Paræcious, but occasionally diæcious or autæcious.* Male bracts in 1 to 2 (3) pairs below the female bracts, strongly concave and more or less imbricate, subtransversely oriented, broadly ovate or ovate-orbicular, not or weakly cordate at base, widest below the middle, from 580 to 600  $\mu$  wide  $\times$  480 to 500  $\mu$  long, little larger than subtending leaves, similar to them in shape, but some with a rounded, obtuse, ill-defined antical lobe or angulation; usually 2-androus. Antheridia subspherical, *ca.* 95 to 100  $\mu$  in diameter when mature; stalk biseriate. Female bracts broadly ovate-orbicular to ovate-cordate, usually much wider than long, *ca.* 700  $\mu$  wide  $\times$  540 to 560  $\mu$  long or slightly larger, widest in basal third, relatively narrowly rounded distally, occasionally as long as wide and 725  $\mu$  wide  $\times$  long, then ovate-cordate. Perianth 4- to 5-plicate, at mouth narrowed; mouth crenulate with short, finger-like cells that are free only at their ends, the cells somewhat evenly thick-walled, 11 to 13.5  $\mu$  wide  $\times$  22 to 32 (35)  $\mu$  long, averaging 2 to 3 times as long as wide, somewhat longer than the cells below them.

**TYPE.** Moist humus, steep, snow-fed W. slope of The Dean, Alert, Ellesmere Island (*Schuster, 35408*; with capsules).

**COTYPES.** Scattered in damp, calcareous tundra slopes, between Dumbbell Bay and The Dean (*35050d*). Damp, rocky slope, above Parr Inlet, 250 to 300 feet, around a "lemming-warren," 1 mile S. of Alert (*35070b*). Damp, weakly calcareous humus over basic weathered slope at foot of Mt. Pullen (*35133*). Damp, calcareous solifluction slope head of Parr Inlet, S. of Alert (*35144*). Damp, weakly basic clay-shale slopes, valley between Peak 1 and Peak 2, *ca.* 850 to 950 feet, *ca.* 5 miles SW. of end of Hilgard Bay (*35548b*). Damp, snow-fed, weakly calcareous, weathered slopes, 2,000 to 2,200 feet, E. edge of U.S. Range, 9 to 10 miles due W. of Peak 1 (*35999b, c. per.*). Damp, mossy, basic slope below persisting snowbank, The Dean (*35175*). Damp humus on clay-shale, low escarpment, edge of persistent snow-ice-field, one-quarter mile N. of Mt. Pullen (*35368a, c. caps.*). Moist humus, steep, snow-fed W. slope of The Dean (*35408*).

The plant is described as a form of *S. polaris* largely because it is more apt to be mistaken for other species in the subgenus *Solenostoma* (such as *S. sphaerocarpum*) than for *S. polaris*. When typical shoots of the variety *cavifolius* are at hand, confusion with *S. polaris* is hardly possible. The leaves of such plants are very broad-based and not at all cordate; they are strongly transverse and as much as 725  $\mu$  wide but only 525  $\mu$  long (width 1.3 to 1.4  $\times$  the length!). Yet, in northeastern Ellesmere Island, these plants can be found intergrading with more nearly typical phases of *S. polaris*. The extreme variation in leaf shape and the equally marked variation in shape of the male and female bracts, together with the often disturbing production of unisexual shoots, make recognition of the *S. polaris* complex in the American Arctic very difficult. The possibility exists that some of the earlier reports from Ellesmere Island of *S. sphaerocarpum* var. *nana* and *S. atrovirens* var. *gracilis* may prove referable to *S. polaris*, particularly to this variety.

Müller (1951-1958) still refers "*Haplozia polaris*" to *Solenostoma atrovirens*, stating that the "var. *polaris*" represents an arctic phase, with more circular leaves, and that "die für *Haplozia polaris* als charakteristisch angegebene Reihe quadratischer Blattrandzellen kommt auch beim Typus (i.e.,



*Solenostoma atrovirens*) vor." It is thus possible that three extremes should be recognized within *S. polaris*, the extreme arctic phase here assigned to fo. *cavifolius*; typical *S. polaris*; and a non-arctic phase with the rounded-ovate to ovate leaves of "*S. schiffneri*." In any event, the extreme, concave-leaved phase with leaves broader than long, which is described at length above, can hardly be referred to typical *S. polaris*.

The fo. *cavifolius* occurs under much the same conditions as typical *S. polaris*. It was found fruiting from July 1 to 27. The plant occurred under a variety of conditions, and one of the cotypes (35050) was found exposed as early as June 3, on a rocky-clayey slope at the edge of an intermittent stream, on the first day of the season when any perceptible snow-melt occurred. Associated were *Scapania gymnostomophila*, *Arnellia*, *Blepharostoma*, and a series of mosses, among them *Hypnum revolutum*, *Tortula ruralis*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Barbula icmadophila*, *Timmia austriaca*, *Mnium hymenophyllum*, *Anoetangium tenuinerve*, and *Philonotis fontana*.

## 26. *Solenostoma pumilum* (With.) K. Müller

Admixed with mosses, crowded on clay-shale, damp slope, SW. base of Mt. Pullen, 800 to 1,000 feet (35783, c. caps.). Exposed, damp, calcareous soil over loosely incorporated scree slope, snow-fed hills SW. of Mt. Pullen (35731, c. caps.; transitional to *S. polaris*).

Collection 35783 is critical, in that it presents some of the features of *S. polaris*, although in most respects clearly belonging to *S. pumilum*. In the most critical features, such as capsule-wall anatomy, form of perianth, the female bracts, the plants are clearly *S. pumilum*. The epidermal cells of the capsule (in and near the middle of the valves) average about  $19 \text{ to } 23 \times (21) 23 \text{ to } 28 \mu$ ; in many areas they are quadrate and mostly  $21 \text{ to } 23 \times 21 \text{ to } 23 \mu$ . In the latter instance, the longitudinal walls bear 1, less often 2 nodular thickenings, the transverse walls either 0, less often 1 thickening. In the occasional elongated, rectangulate cells which are found, the longitudinal walls bear 1 to 2(3) thickenings and the transverse walls 0 to 1(2) thickenings. The very few thickenings and the relatively large cell-size of the epidermal cells closely match those assigned to this species by Schiffner (1908) and Müller (1909), as contrasted to the smaller cells, with more numerous thickenings, observed in *S. "schiffneri"* (see under *S. polaris*). The female bracts, in almost all instances, are somewhat elongated, oval to oblong-oval or oblong-ovate; they are commonly about  $625 \mu$  wide  $\times$   $720 \mu$  long to  $650 \mu$  wide  $\times$   $780 \mu$  long (the length measured along the median axis of the bract). The male bracts are variable but are often broadly ovate and slightly wider than long ( $525\text{--}550 \mu$  wide  $\times$   $500\text{--}575 \mu$  long). The perianth is clearly that of *S. pumilum*, with the distal 0.4 to 0.5 strongly conically narrowed; the subapical cells average (16)  $17 \text{ to } 19 \mu$  wide  $\times$  long; those at the irregularly crenulate mouth are  $15 \text{ to } 20 \mu$  wide  $\times$   $20 \text{ to } 34 \mu$  long.

The leaves and leaf-cells, by contrast, closely approach those of *S. polaris*. In many cases, the leaves are narrowly ovate (from  $370 \text{ to } 390 \mu$  wide  $\times$   $410 \text{ to } 450 \mu$  long; averaging  $1.08 \text{ to } 1.16 \times$  as long as wide) but elsewhere, in the same patch of plants, the leaves may be broadly ovate or rotundate and from  $400 \mu$  wide  $\times$   $400 \mu$  long to  $470 \mu$  wide  $\times$   $450 \mu$  long



(0.95 to 1.0 as long as wide), or even broadly rotundate and  $550\ \mu$  wide  $\times$   $450\ \mu$  long (0.82 as long as wide; then inserted by a very broad base, much as in *S. polaris* fo. *cavifolius*). Even more disturbing than these unusually broad leaves, for *S. pumilum*, are the small leaf cells. Those of the leaf-margins average, distally, ca. 13 to  $16\ \mu$ , tangentially measured. The median cells are subquadrate above and from  $18$  to  $19 \times 18$  to  $23\ \mu$ , becoming narrowed below and  $16$  to  $18\ \mu$  wide  $\times$   $23$  to  $35\ \mu$  long. Such cells are clearly identical with those of *S. polaris* in size! As a consequence, sterile shoots of this type would surely be placed as *S. polaris*, fertile ones as *S. pumilum*!

The spores and elaters of these plants fail to show features allowing a discrimination between the two taxa: the former are very variable in size, ranging from a minimum (exceptional) of  $16.5\ \mu$  to a maximum of  $23.5\ \mu$ ; most average between  $18$  to  $20\ \mu$ . The elaters are ca.  $9$  to  $10\ \mu$  in diameter.

Although the plants of 35783 are apparently referable to a broad-leaved arctic phase of *S. pumilum* (analogous to fo. *cavifolius* of *S. polaris*), the plants of 35731 are highly critical and even more nearly intermediate.

Plants of 35783 were sent to Dr. Arnell for verification; he believed they might represent *S. atrovirens*! However, in both of the collections here referred to *S. pumilum*, I was able to demonstrate parœcious inflorescences beyond any doubt.

#### CRYPTOCOLEA Schuster

##### 27. *Cryptocolea imbricata* Schuster

Over humus, damp, weakly basic slope, weathered sedimentary rocks at foot of The Dean (35156, 35156g). Over damp, weakly basic humus over steep, much-weathered slope, below persisting snowbank (35250a, 35231b). In mats over calcareous, humus-covered slopes, S. end of Hilgard Bay (35225, 35235). Over moist, thin peaty soil on weathered basic slopes, snow-fed E. face of Mt. Pullen (35307a, 35307b). Moist moss tundra, flat calcareous clay-loam outwash plain NE. of Mt. Pullen (35383, 35381). Moist, basic, humus-covered, snow-fed slope of The Dean (35409). Among mosses, clay-shale calcareous slope, edge of polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35638d). Humus-covered, damp, snow-fed, calcareous clay-shale slope, SW. Mt. Pullen (35792c). Damp humus, over steep clay-shale slope, S. end of Hilgard Bay (35932a, 35932c, 35934).

The original material of this monotypic genus came from Minnesota and Michigan where the plants were reported as occurring with *Tritomaria scitula*, *T. quinquedentata*, *Lophozia heterocolpa*, *Plagiochila asplenoides*, *Blepharostoma trichophyllum*, *Scapania gymnostomophila*, *Lophozia gillmani*, and *Fissidens* (Schuster, 1953); the plant was there confined to sites in the "tundra strip" along the immediate shore of Lake Superior (Schuster, 1958a). The presence of a variety of taxa with disjunct ranges in the Lake Superior region has been recently documented in Schuster (1958a, 1958b); hence the discovery of *Cryptocolea* in the questionably glaciated region of northern Ellesmere Island is of much interest. In the Alert area the plants occur chiefly in relatively rich moss-tundra over incorporated, stabilized, clay-shale slopes; they are absent on the wetter clay solifluction slopes, and on the drier, looser, scree slopes. Associated are a group of



Hepaticae, of which the first six also occurred with the species at the type locality: *Blepharostoma trichophyllum* ssp. *brevirete*, *Scapania gymnostomophila*, *Lophozia gillmani*, *Lophozia heterocolpa* (and the var. *harpanthoides*), *Tritomaria quinquedentata*, *Odontoschisma macounii*, *Arnellia fennica*, *Cephaloziella arctica*, *Lophozia quadriloba*, *L. pellucida*, *Tritomaria heterophylla*, *Anthelia juratzkana*, *Gymnomitrium concinnatum*, *Scapania polaris*, *Lophozia muelleri*, and *Trichostylium pinguis*. The following mosses were commonly associated: *Fissidens arcticus*, *Timmia austriaca*, *Didymodon recurvirostris*, *Hypnum cupressiforme*, *Pohlia cruda*, *Bryum capillare*, *Barbula icmadophila*, *Isopterygium pulchellum*, *Campylium stellatum*, *Holmgrenia stricta*, *Encalypta alpina*, *Philonotis fontana*, *Amblystegiella sprucei*, *Tomenthypnum nitens*, and *Ditrichum flexicaule*.

As at the type locality, the plants are not infrequently fertile (both male and female plants were found in 35156 and 35307a); however, no trace of capsules could be found, nor could any trace of asexual reproduction be determined. As with the type material, the plants were virtually unbranched, except that the female plants invariably innovated. However, the rather abundant Alert material showed occasional true branches, which were all solitary, furcate, and terminal in origin. The oil-bodies closely matched those of the type material, although in some collections the oil-bodies were more nearly homogeneous, with only a series of smaller segments cut off along one side of the oil-body. With repeated study of the Alert material, as well as restudy of the type, I am now convinced that the genus belongs more probably in the Jungermanniaceae, near *Nardia* (from which it differs in the total lack of underleaves), than in the Plagiochilaceae. In the original diagnosis the possibility of an affinity to both families was mentioned.

## PLAGIOCHILACEAE

### PLAGIOCHILA Dumort.

#### 28. *Plagiochila arctica* Bryhn & Kaalaas

In patches over moist, peaty soil over basic, steep, weathered slopes, late snow areas, Mt. Pullen (35301a, 35349a). East edge of U.S. Range, 2,000 to 2,200 feet, 9 to 10 miles W. of Peak 1 (35570, 35570a, 35599c). One-fourth mile N. of Mt. Pullen, N. face of Mt. Pullen, and E. face of Mt. Pullen (35310, 35301g, 35329, 35338, 35349, 35368, 35376, 35377). Northwest slope of The Dean (35191).

The specimens from northeastern Ellesmere closely match the type collection, made by Simmons during the "*Fram*" expedition, of which I have seen several examples from Cape Rutherford. These plants are all small, strongly laterally compressed, with broadly oval to subreniform, entire-margined leaves, bear very abundant stolons, and are a dull yellow-green in the field. The plants individually closely simulate *Nardia compressa*. In these plants, growing very crowded amidst mosses and other Hepaticae, the shoots are only 8 to 12 mm high, and the maximal width is ca. 1.3 to 1.8 mm. This maximal width is equal to the leaf width, since the leaves are imbricate, erect-appressed, with the consequence that, in antical aspect, the shoot is very narrow and appears strongly laterally compressed. The leaves are distinctly reniform or broadly orbicular-reniform, with an



average width *ca.* 1,450 to 1,500  $\mu$   $\times$  1,050 to 1,100  $\mu$  long (width ranging from *ca.* 1.35 to 1.45  $\times$  the length), and are commonly sparingly and obscurely repand-dentate, with anywhere from 1 to 2, to 5 to 7 low, obscure teeth. Such compact phases are further characterized by the free production of leafless stolons, which originate apparently consistently, as do the leafy lateral branches, from the lower portions of the leaf axils (i.e., as intercalary branches; terminal branches have not been seen in any phase of the *P. asplenoides-arctica-columbiana* complex). The production of stolons in other phases of *P. arctica* is rare and sporadic. The separation of this species, if it indeed deserves specific status, from *P. asplenoides* var. *subarctica* is technical (see Schuster, 1959). Habitually the two are inseparable.

In the Alert area the species is rare, confined to calcareous moss-tundra, and is associated with the same range of species as are found with the ecologically equivalent *P. asplenoides* var. *subarctica*, namely: *Lophozia pellucida*, *L. quadriloba*, *L. heterocolpa* and its var. *harpanthoides*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Scapania polaris*, *S. gymnostomophila*, less often *Cryptocolea imbricata*, *Eremonotus minutus*, *Anthelia juratzkana*, *Arnellia fennica*, *Solenostoma polaris*, *Tritomaria quinquedentata*, *T. heterophylla*, *Cephaloziella arctica*, *Gymnomitrium corallioides*, and *G. concinatum*.

*P. arctica* has been reported a very few times from North America, and in addition to the stations reported by Bryhn (1906) from central and southern Ellesmere Island, is known from many stations in Alaska (Schuster, 1959; Persson, 1946). As both of these authors point out, the reports of this species from Alaska and from Quebec by Frye & Clark refer, at least in part, to *P. asplenoides* and to *Chiloscyphus*. The present collections represent the northernmost known for the species.

## 29. *Plagiochila asplenoides* var. *subarctica* Joerg.

Moss-tundra over gravelly, sloping shoreline of Arctic Ocean, within 20 to 40 feet of the edge of permanently frozen ice pack, just W. of Cape Belknap, 1.5 miles from Alert (35625).

This variety, reported from northern Scandinavia, has not been previously found in North America. It represents a high arctic phase, identical in facies to typical *P. arctica* (q. v.), thus habitually very unlike other forms of *P. asplenoides* (see Schuster, 1959). The local collection agrees with more normal forms of *P. arctica*, from temperate climates, in possessing (2 to 4) 5 to 8 (9) oil-bodies per median cell. By contrast, the *P. arctica* collections from the Alert area possess 15 to 24 oil-bodies per cell. The Ellesmere plants of these two species are illustrated in detail in Schuster (1959). The Cape Belknap plants are perfectly typical as to cell size but otherwise closely resemble *P. arctica* in size, colour, and facies. The plants, like all regional phases of *P. arctica*, are small (barely 8 to 15 mm high), extremely flattened laterally, yellow-green, and have imbricate, erect-appressed, very broadly dilated, nearly flat, subreniform and subentire or entire leaves. The leaves of well-developed shoots average from 1,750  $\mu$  wide  $\times$  1,050  $\mu$  long up to 2,000  $\mu$  wide  $\times$  1,450  $\mu$  long (i.e., from *ca.* 1.35 to 1.65  $\times$  as wide as long); they are strongly contracted and rounded to a



very narrow base, and are short-decurrent antically. The leaf-shape and entire facies can scarcely be approached in any of the hundreds of collections seen from the more "temperate" phases of the species.

In all of these respects, the plants perfectly match *P. arctica* from the same area, yet the two taxa differ very greatly in cell size and in the number of oil-bodies per cell (as is evident from a comparison with plants of *P. arctica* from The Dean, barely 6 miles south of Cape Belknap):

TABLE II

|                                   | <i>P. asplenoides</i>       | <i>P. arctica</i>        |
|-----------------------------------|-----------------------------|--------------------------|
|                                   | (Cape Belknap)              | (The Dean)               |
| Marginal and subapical cells..... | 16-19 and up to 17-23 $\mu$ | (29) 30-36 $\mu$         |
| Median cells.....                 | 23-25 X 23-28 (30) $\mu$    | 38-44 X 40-46 $\mu$      |
| Basal cells.....                  | 23-28 (30) X 25-38 $\mu$    | (29) 32-38 X 40-60 $\mu$ |
| Oil-bodies per median cell.....   | (2-4) 5-8 (9)               | 15-24                    |

These differences are identical in nature and similar in magnitude to those which separate, for instance, *Tritomaria quinquedentata* from its var. *grandiretis*.

Ecologically, this variant seems similar to *P. arctica*, at least locally, occurring in damp, calcareous moss-tundra, associated with *Lophozia pellucida*, *L. quadriloba*, *L. heterocolpa* var. *harpanthoides*, *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cryptocolea imbricata*, and *Scapania gymnostomophila*.

The present collection represents the northernmost one for this species as well as for this predominantly tropical genus and family.

## SOUTHBYACEAE

### ARNELLIA Lindb.

#### 30. *Arnellia fennica* (Gottsche) Lindb.

Clay-shale slope, highly calcareous, between Dumbbell Bay and The Dean (35060a). Over damp, calcareous clay, rocky slope, Alert, at base of Cape Belknap; northernmost known station (35068, 35068a). Moist clay-shale slope along ravine, 2 miles S. of Alert (35050a). Moist depression in otherwise dry *Saxifraga oppositifolia* slope, over clay and shale, Dumbbell Bay, near Alert (35080a). Damp, rocky slope above Parr Inlet, ca. 250 to 300 feet, around a "lemming-warren," one mile S. of Alert (35070). Damp, clay-shale, solifluction slope, head of Parr Inlet, S. of Alert (35141c, 35154, 35145, 35145a). Over weakly basic humus on weathered slope, foot of Mt. Pullen (35102d, 35121b). Damp, mossy, basic slope below persisting snowbank, The Dean (35171, 35175). Moist, calcareous clay-shale slope, below persisting snowbank, 2.5 miles W. of Cape Belknap, S. of Williams Island and mouth of Black Cliffs Bay, opposite Cape Woolen



(35205, 35212). Damp, clay-shale, calcareous slope, below persisting snowbank, S. end of Hilgard Bay (35231, 35231b, 35225, 35225a, 35225b, 35234, 35234b, 35256). Damp, thin humus over calcareous weathered slope, below persistent snowbank, S. end of Hilgard Bay (35235, 35250, 35926, 35928, 35929, 35932, 35932a). Moist moss-tundra, flat, calcareous clay-loam outwash plain, NE. of Mt. Pullen (35381, 35382, 35383, 35383a). Among mosses, moist steep, weakly basic, weathered, snow-fed slope, valley between Peak 1 and Peak 2, ca. 5 miles SW. of end of Hilgard Bay, 800 to 950 feet (35521, 35543, 35546, 35549a). Moist, snow-fed, steep, basic slope, ca. 1,800 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35571). Damp, weakly calcareous, snow-fed slopes, 2,000 to 2,200 feet, E. of edge of U.S. Range (35599, 35599a). In yellowish-brown mats, over calcareous clay-shale slope, edge of beach, just above permanent polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35633, 35633a). Damp, calcareous, moss-covered clay-shale slope, edge of frozen Lincoln Sea, edge of polar ice-cap, 1.5 to 2 miles W. of tip of Cape Belknap (35750a, 35634a, 35634b, 35634c, 35635 [=35638c], 35638d). Moist, calcareous moss-covered clay-shale slope, edge of frozen polar ice-cap, 2 miles W. of tip of Cape Belknap (35817, 35823).

This characteristic arctic calciphile is one of the very few hepatics found commonly in the Alert area; it is the only one with any tendency to occur in pure, extended mats. The species occurs in a variety of sites, ranging from moist run-off crevices in otherwise exposed, dry, saxifrage barrens (then in small quantity amidst various mosses, chiefly *Aloina brevirostris*, *Encalypta alpina*, *E. procera*, *Barbula icmadophila*, *Anoetangium tenuinerve*, *Holmgrenia chrysea*, *Ditrichum flexicaule*, *Timmia norvegica*, the hepatics *Athalamia hyalina* and *Blepharostoma trichophyllum* ssp. *brevirete* and *Salix arctica*) where there is very little snow cover, to rich moss-tundra, irrigated continuously during the growing season by snow-melt. Locally the plants appear to be nearly always sterile, although gemmae are commonly produced on the abaxial leaf surfaces. Only the optimally developed plants of 35633 are provided with perianths.

The plants are found most often on moist, weakly basic humus or soil, often on damp, calcareous clay-shale slopes, and then are associated with *Lophozia heterocolpa*, *L. quadriloba*, *L. pellucida*, *L. gillmani*, *Cephalozia arctica*, *Tritomaria quinquedentata*, *T. heterophylla*, *Solenostoma polaris*, *Scapania gymnostomophila*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cryptocolea imbricata*, *Plagiochila asplenoides subarctica*, rarely *Moerkia flotowiana*, *Athalamia hyalina*, *Trichostylium pinguis*, *Lophozia muelleri*, *L. badensis*, *Plagiochila arctica*; associated mosses are most often *Holmgrenia chrysea*, *Philonotis fontana*, *Barbula icmadophila*, *Timmia austriaca*, *Encalypta alpina*, *E. procera*, *Anoetangium tenuinerve*, *Ditrichum flexicaule*, *Catoscopium nigrum*, *Cirriphyllum cirrosum*, *Tomenthypnum nitens*, *Didymodon recurvirostris*, *Distichum capillaceum*, *Myurella julacea*, *M. tenerrima*, less often *Mnium orthorhynchum*, *M. hymenophyllum*, *Tortula ruralis*, and *Amblystegiella sprucei*. Equally frequent on wet, continuously irrigated clay-shale solifluction slopes (as on Colan Bay and at head of Parr Inlet), associated with *Trichostylium pinguis*, *Athalamia hyalina*, *Blepharostoma trichophyllum* ssp. *brevirete*, and various mosses (*Ditrichum flexicaule*, *Timmia austriaca*, *Holmgrenia chrysea*, *Encalypta alpina*, *Barbula icmadophila*). The species is one of the most tolerant of the local



hepatics, occurring in sites along the snow-melt laden intermittent streams that are uncovered long before the majority of the land surface is snow-free, as for example in 35050; here it occurs with *Scapania gymnostomophila*, *Solenostoma polaris*, *Cephaloziella arctica*, *Blepharostoma trichophyllum* ssp. *brevirete*, and the mosses *Hypnum revolutum*, *Tortula ruralis*, *Ditrichum flexicaule*, *Distichium capillaceum*, *Barbula icmadophila*, *Timmia austriaca*, *Mnium hymenophyllum*, *Anoetangium tenuinerve*, and *Philonotis fontana*.

## MARSUPELLACEAE

### MARSUPELLA Dumort.

#### 31. *Marsupella ustulata* (Hueben.) Spruce

Sparse, brownish plants, soil-filled crevices of indurated, vertically bedded, noncalcareous slates, deep ravine emptying into Hilgard Bay (35902a).

The present collection consists of only a very few fertile, clearly parœcious plants, growing among *Gymnomitrium corallioides*, closely adjacent to *Scapania lapponica*, *Cephaloziella grimsulana*, and other regionally extremely rare species. The plants appear to be referable here, rather than to the very similar *M. sprucei* (which is known from near Thule, Greenland), because of the cell size. The marginal cells, in the lobes of sterile leaves, average 9 to 12 (13)  $\mu$ ; those of the middle of the free lobes gradually increase in size to (12) 13 to 15 (18)  $\mu$ ; the median cells average (12) 14 to 17  $\times$  15 to 20  $\mu$ . On the male and female bracts the cells are scarcely larger, the marginal averaging 10 to 12 (13)  $\mu$ ; those of the middle of the free lobes (12) 13 to 16 (18)  $\mu$ ; those of the middle of the leaves (13) 15 to 19  $\times$  15 to 20  $\mu$ . The cells of the lobes have almost consistently 2 oil-bodies per cell, averaging 4 to 4.5  $\times$  6  $\mu$  up to 5 to 6  $\times$  7 to 9  $\mu$ ; in the median cells, occasional cells have 3, but apparently never 4 oil-bodies. The oil-bodies are finely granular, subspherical to ovoid or ellipsoidal, 4 to 4.5  $\times$  5 to 6  $\mu$  up to 5 to 6  $\times$  7 to 9  $\mu$ .

Although *M. ustulata* extends in Europe to northern Scandinavia, it has not been reported from north of Nova Scotia and British Columbia in North America. It appears to be generally low Arctic and Alpine, rather than high Arctic. The present report extends the range of the species northward in the New World over 1,000 miles.

### GYMNOMITRIUM Corda

#### 32. *Gymnomitrium corallioides* Nees

Over moist, peaty humus on basic, weathered slopes, Mt. Pullen (35301, 35347). In greyish-white patches over exposed humus, shallow soil, over much weathered shoulder of The Dean (35391, 35398). Moist, exposed humus-covered scree, snow-fed, ca. 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 8 to 10 miles due W. of Peak 1 (35574, 35574a, 35614, 35595, 35595b). Exposed, locally soil-covered depressions in loose scree, near summit of Mt. Pullen (35757, 35760). Damp, shaded crevices, vertically bedded, indurated, noncalcareous shale and slate ledges, deep ravine at S. end of Hilgard Bay (35902).



Although reported from a number of stations on the Greenland coast and from southern and central Ellesmere Island, these reports appear to be the northernmost for the species; it will surely be found in similar environments in northernmost Greenland.

The species occurs, occasionally, in extensive silvery-grey patches, over noncalcareous, locally soil-covered depressions in loose scree; over thin, damp humus on snow-fed scree slopes; over moist, exposed soil over basic, weathered mountain slopes; and in whitish patches over exposed soil, among extensively weathered rocks; and in depressions in late snow areas near the summits of the lower mountains. Rarely, in plants from sheltered sites, the shoots are greenish, and then difficult to separate from *G. concinnatum*. In general there are a variety of lichens associated, as well as a number of characteristic mosses, among them *Pogonatum capillare*, *Pohlia cruda*, *Racomitrium lanuginosum*, *R. canescens*, *Orthotrichum killiasii*, *Hypnum revolutum*, *Isopterygium pulchellum*, *Polytrichum piliferum*, *P. alpinum*, *Myurella tenerrima*, occasionally *Timmia austriaca*. Associated Hepaticae are usually few, chiefly *Anthelia juratzkana*, *Eromonotus minutus*, *Scapania polaris*, *Lophozia alpestris major*, *Gymnomitrium concinnatum*, more rarely *Tritomaria quinquedentata* and *Cephaloziella arctica*. The only material of *Marsupella ustulata* collected was found in crevices of indurated, vertically bedded, but rotting slates, amidst *Gymnomitrium corallioides*.

Much of the regional material of *G. corallioides* tends to produce very blunt leaf-lobes and on this account might be confused with *G. obtusum*.

### 33. *Gymnomitrium concinnatum* (Lightf.) Corda

Damp, weakly basic humus over shale slope below persisting snow-field, The Dean (35156, 35156e, 35156g). In brownish patches over exposed humus, over snow-fed, moist, basic, weathered slopes, Mt. Pullen (35328, 35349a, 35353, 35353a, 35353b, 35353c). Damp, peaty soil, weathered basic slopes of Mt. Pullen, in late snowdrift area (35301b). Dry, exposed loose scree slopes, crest of ridge ca. 5 miles due W. of Peak 1 (35551).

*G. concinnatum* has not been found previously at latitudes as high as those here reported, although like *G. corallioides*, it can surely be expected from northernmost Greenland. It has not been previously reported north of Baffin and Philpots Islands (from the latter it was reported as long ago as 1871 by Dickie). Although almost restricted to exposed and dry rocky sites in alpine situations, the species appears to become less restricted ecologically at high latitudes. In the Alert area, for example, it occurs variously on dry, exposed scree slopes (with *Racomitrium canescens*, *R. lanuginosum*, *Grimmia apocarpa*, *Bartramia ithyphylla*, *Hypnum cupressiforme*, *Ditrichum flexicaule*, *Holmgrenia chrysea*, *Gymnomitrium corallioides*, and *Eromonotus minutus*) as well as on bare, peaty humus lying over weakly basic rocks, often where irrigated by snow-melt, associated with a series of lime-tolerant species (*Cryptocolea imbricata*, *Anthelia juratzkana*, *Tritomaria heterophylla*, *T. quinquedentata*, *Cephaloziella arctica*, *Plagiochila arctica*, *Lophozia heterocolpa*, *L. quadriloba*, *L. alpestris* var. *major*, *Odontoschisma macounii*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Scapania polaris*, and *Arnellia fennica*). Associated mosses, under such conditions, included, chiefly *Timmia austriaca*, *Didymodon recurvirostris*, *Hypnum cupressiforme*, *Pohlia cruda*, *Bryum capillare*, *Barbula icmadophila*, *Isopterygium pulchellum*,



and *Fissidens arcticus*. Under such conditions *G. concinnatum* often occurred on moss-rich slopes below persisting snowbanks, or below firn-ice-filled valleys, at sites where snow persists until late in the season (June 15-20, or later).

## HYGROBIELLACEAE

### ANTHELIA Dumort.

#### 34. *Anthelia juratzkana* (Limpr.) Trev.

Damp, clay-shale slope, basic weathered foot of Mt. Pullen, sometimes below persisting snowbanks (35111, 35103a, 35103b, 35103c, 35104c, 35109). Damp, weakly basic moss heath below persisting snowfield, The Dean (35160, 35160a, 35177a, 35181, 35181a, 35594). In silvery-grey to grey-green patches, over humus, slope draining persistent snowbank, NW. side of The Dean (35156, 35156d, 35169). Moist, basic, humus-covered slopes, Mt. Pullen (35302, 35313d, 35344, 35348a, 35349a). Moist, basic, snow-fed, strongly weathered slopes, Mt. Pullen (35345, 35347). Moist, peaty soil, over basic weathered slopes, Mt. Pullen, sometimes in late snow areas (35301a, 35313c, c. per.; 35325a, 35337, 35353a). In late snow area (permafrost an inch from top on July 27; snowfield within 1 to 2 feet), shallow depression on The Dean, ca. 900 feet (35594, 35399). Exposed, thin soil, over loosely incorporated steep scree slope, 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35613, 35615). Over peaty, thin humus on calcareous clay-shale, SW. end of Mt. Pullen, ca. 900 to 1,000 feet (35793). Greyish patches over exposed humus, overlying calcareous, damp, snow-fed, clay-shale slope, SW. end of Mt. Pullen (35795a).

The present reports appear to represent a considerable extension northward in range, although Bryhn (1906) reported the species from a variety of stations in southern and central Ellesmere Island. The species behaves in the Alert area very much as it does in alpine situations farther southward: it occurs largely on soil-covered rocky areas where snow persists until late and where the mats are kept damp by snow-melt. Locally the plants may occur in mats where snow lies until after the middle of June, or even after the middle of July; on The Dean it is found near the head of a firn-ice-filled valley, where permafrost lies, even in July, only an inch or so below the moss-mat in which the *Anthelia* is found. Associated were *Tritomaria heterophylla*, *T. quinquedentata*, *Cephaloziella arctica*, *Lophozia alpestris* var. *major*, *Polytrichum alpinum*, *Pohlia cruda*, *Hypnum callichroum*, *Bartramia ithyphylla*, *Aulacomnium turgidum*, and *Isopterygium pulchellum*. The plant then occurs as a glaucous, bluish-green, lax, elongated, erect phase that is almost wholly sterile; such plants correspond closely to fo. *elongata* Joerg., which Joergensen (1934, p. 250) describes as to 10 to 15 mm high and with thick-walled leaf-cells. Such plants may be habitually very similar to *A. julacea*, but the very few inflorescences found were definitely parœcious. The plant is more frequent as a minute, prostrate, silvery phase, only 2 to 4 mm long, growing closely appressed, sometimes forming small, dense sods, associated with *Gymnomitrium corallioides* and *concinnatum*. When growing more nearly optimally, on humus over basic rocks, with *Cephaloziella arctica*, *Lophozia heterocolpa*,



*L. quadriloba*, *L. alpestris* var. *major*, *Tritomaria heterophylla*, *T. quinquedentata*, *Odontoschisma macounii*, *Aulacomnium palustre* and *turgidum*, *Pohlia cruda* and *nutans*, *Timmia austriaca*, *Philonotis fontana*, *Dicranum majus*, *Ditrichum flexicaule*, *Myurella julacea*, more rarely *Scapania polaris*, *Arnellia fennica*, *Plagiochila arctica*, *Cryptocolea imbricata*, *Fissidens arcticus*, *Mnium hymenophyllum*, and *Holmgrenia chrysea*. In spite of the virtual restriction to late snow areas ("Schneetälchen") it produces capsules abundantly, even in the Alert area. Indeed, this species and *Solenostoma polaris* were the only two leafy hepatics found regularly with capsules. These, locally, were found rarely in late June, usually from the middle of July to the middle of August.

## CEPHALOZIELLACEAE

### CEPHALOZIELLA (Spruce) Schiffn.

#### 35. *Cephaloziella arctica* Bryhn & Douin ex K. Müller

Damp, calcareous slope, soon snow-free, Alert (35051b, 35059). Among mosses, damp, snow-fed tundra bank over calcareous shale and clay slope, between Dumbbell Bay and The Dean (35054). Among mosses, over moist calcareous clay-shale slope, along ravine 2 miles S. of Alert (35050b, c. *gem.*). Moist, calcareous polygon soil, edge of temporary pond, between Alert Weather Station and Dumbbell Lake (35063, 35068a). Damp, rocky slope, above Parr Inlet, ca. 250 to 300 feet, around a "lemming-warren," a mile S. of Alert (35070). Damp, clay-shale slope, fed by snow-bank, Dumbbell Bay, near Alert (35082). Damp, weakly basic clay-shale slope, foot of Mt. Pullen, below persisting snowbank (35101b, 35104b, 35111, 35112, 35118c). Among mosses, intermittently damp snow-fed slope, Mt. Pullen (35124). In mats on moss-covered slope below large snowbank, N. face of Mt. Pullen (35103b, 35103c). Among *Drepanocladus* and other mosses on a basic solifluction slope, shallow gorge below snowbank, NW. side of The Dean (35167). Damp, weakly basic moss-heath below persistent snowbank, The Dean (35169, 35177a, 35180a, 35182a, 35186a). In blackish patches over humus, damp calcareous slopes at S. end of Hilgard Bay (35236, 35238). In shiny, blackish patches over humus, snow-fed, calcareous, weathered slopes, E. face of Mt. Pullen (35302a, 35302b, 35334, 35336, 35336a). Over rather dry, exposed, weathered, weakly basic slopes, Mt. Pullen (35340b, c. *caps.*). Over damp, weakly basic, exposed, steep weathered slopes, Mt. Pullen (35332, 35343, 35343a, 35353a, 35354, 35354a). Damp, peaty, thin humus over calcareous weathered slope, Mt. Pullen (35316a). Moist, calcareous clay slope, Cape Belknap (35292). Damp, snow-fed, well-drained humus-covered scree slopes, The Dean, ca. 850 to 900 feet (35392a, 35397a). Barely damp, exposed humus over weathered steep rock slope, The Dean (35401, 35401b). Moist, weakly basic, steep, weathered calcareous clay-shale slope, valley between Peak 1 and Peak 2, ca. 5 miles SW. of end of Hilgard Bay (35521, 35546a, 35548, 35548a, 35548b). Exposed damp humus, snow-fed, calcareous scree slope, 1,800 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles W. of Peak 1 (35574a, 35575, 35614a, 35612, 35594, 35563). Snow-fed drainage grooves near summit of scree-covered, weathered, low mountains, E. edge of U.S. Range, ca. 3,000 feet, 9 to 11 miles due W. of Peak 1



(35593b). In patches over calcareous clay-shale slope, shore of frozen Lincoln Sea, polar basin 1.5 to 2 miles W. of tip of Cape Belknap (35636). Exposed, thin soil over loosely incorporated, steep, snow-fed calcareous scree slope, hills SW. of Mt. Pullen (35731, 35731a). Exposed humus over moist, snow-fed calcareous clay-shale slope, SW. end of Mt. Pullen ca. 900 to 1,000 feet (35792e). Moist, clay-shale slopes, SW. side of Mt. Pullen, ca. 1,200 to 1,400 feet, below snowbanks (35762). Moist humus over calcareous, steep, clay-shale slope, S. end of Hilgard Bay (35932a, 35932b).

The plants here placed in *C. arctica* embrace a variable series but surely cannot be separated into two or more species; *C. alpina* hardly merits recognition, being a leptodermous phase. The plant appears to be also frequent in calcareous sites in central and southern Ellesmere Island, from which it was reported as *Cephalozia verrucosa* (Bryhn, 1906). The present reports are the northernmost for the species and genus. I have not been able to demonstrate an autœcious inflorescence in all the collections reported above; a considerable number consist of sterile plants or gemmiparous plants. However, in enough of these collections (i.e., 35563, 35050b, 35302a and b, 35340b, 35575, 35593b) it was possible to demonstrate repeatedly autœcious inflorescences, so that the identification of specimens reported here can be regarded as unquestionable. The plants, in general, showed a tendency toward chestnut-brown to purplish-black pigmentation, associated with vineous to purplish gemmae, and a nitid texture when dry; they possessed somewhat shallowly concave and suberect leaves, never with a tendency to be loosely complicate or folded, never with even a trace of a reflexed sinus. Underleaves were always demonstrable on sterile, non-gemmiparous plants, although occasionally rudimentary; they were particularly large on some collections (i.e., in a robust phase, 35182a; in 35101b). Although perianths were not infrequently found, capsules were rare (only in 35340b and 35594; very typical plants). The perianths were deep purplish, except for the decolorate mouth. In general the cells at the bases of the leaf-lobes averaged 10 to 12.5  $\mu$  wide; however, in one collection (35302) they averaged as high as 12.5 to 14  $\mu$ , thus approaching *C. grim-sulana*—a closely allied plant with larger cells, present only very locally.

*C. arctica* has until recently been reported only from Ellesmere Island, Bedford Pim Island, Greenland, and King William Island; the report of the synonymous *C. alpina* from Idaho (Frye & Clark, loc. cit.) has already been questioned by Schuster (1953), who reported the plant from calcareous sites in Minnesota and Michigan. It was also reported from the Hudson Bay area (Schuster, 1951). In all instances the plant appears to be confined to weakly to strongly calcareous sites. The species appears very common northward; indeed in the northernmost land masses of the Northern Hemisphere this appears to be the dominant species of *Cephaloziella*, at least in calcareous sites. In the vicinity of Alert, it is abundant in a variety of sites: (a) As a pioneer on bare calcareous clay slopes, covered by snow nine to ten months of the year, saturated with or covered by water for a few days during the period of spring run-off, desiccated and insolated for 24 hours a day for most of the remainder of the short arctic summer during which less than one inch of rain falls. Associated are such hepatics as *Solenostoma polaris* and *Scapania cuspiduligera*, and such angiosperms as



*Salix arctica*, *Draba* spp., *Cerastium regellii*, *Festuca baffinensis*, and *F. brachyphylla*; (b) As an accessory species in damp to dry tundra, formed largely of a few species of mosses, chief among them *Holmgrenia chrysea*, *Ditrichum flexicaule*, *Pohlia cruda*, *Barbula icmadophila*, with associated hepatics, such as *Scapania gymnostomophila*, *Solenostoma polaris*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Arnellia fennica*, *Lophozia alpestris* var. *major*; and (c) On wet basic, solifluction slopes, irrigated by overlying, permanent snowbanks<sup>1</sup>; then associated are *Lophozia pellucida*, *L. alpestris major*, *L. quadriloba*, *Scapania gymnostomophila*, *Drepanocladus revolvens*, *Philonotis fontana*, *Pohlia cruda*, *Ditrichum flexicaule*, *Myurella julacea*, *Distichium capillaceum*, *Polytrichum alpinum*, *Barbula icmadophila*, *Tortula ruralis*, *Timmia norvegica*, *Dichodontium pellucidum*, *Didymodon recurvirostris*, *Bryobrittonia pellucida*, etc. Over damp, richly moss-covered, basic clay-shale slopes, the preceding species, as well as a large series of others, may occur admixed, among them *Cryptocolea imbricata*, *Solenostoma polaris*, *Lophozia heterocolpa*, *L. gillmani*, and *L. excisa*. Less often the plant occurs under less basic conditions, on exposed, locally soil-covered scree, associated with *Eremonotus minutus*, *Gymnomitrium corallioides*, *Tritomaria quinque-dentata*, *Polytrichum piliferum*, *Timmia austriaca*, *Isopterygium pulchellum*, *Orthotrichum killiasii*, *Hypnum revolutum*, *Tetraplodon urceolatus*, *Aulacomnium turgidum*, and *Pohlia cruda*.

Under pioneer conditions, when growing prostrate over bare clay, the plants are blackish-brown, with characteristically almost erect-appressed, concave leaves; the plants are then habitually sterile. When crowded in a moss-lichen tundra, as accessory species, the plants grow erect, usually only the leaf-tips are blackish-brown, and the plants frequently bear gemmae and sex organs.

### 36. *Cephaloziella grimsulana* (Jack) K. Müller

In blackish patches, damp rock crevices and over damp rocks, near S. end of Hilgard Bay (35226a, 35228). Damp rocks, small ravine cut into head of Hilgard Bay (35227, 35229). In blackish-purple patches, in damp rock-crevices and on vertical rock walls, S. side of Hilgard Bay (35487, c. *gem.*). Damp rocks in small ravine on S. side of Hilgard Bay, ca. 9 miles SW. of Alert (35478). Moist crevices of metamorphosed shale, edge of small ravine emptying into Hilgard Bay (35475). Over soil in moist crevices of vertically bedded, contorted shales, deep ravine, S. side of Hilgard Bay (35911; c. *vinaceous gemmae*; 35911a).

The status of this species remains critical; it is an autœcious plant, tending toward purplish to blackish coloration, and possesses large leaf-cells and distinct underleaves. The leaf-lobes tend to be relatively blunt, although it is very questionable as to how constant this feature is. In the final analysis, the species is allied to *C. arctica* in its inflorescences, coloration, and possession of underleaves, as well as in the generally suberect orientation of the leaves. From this it appears to differ essentially in the considerably larger cells and larger gemmae.

<sup>1</sup>It is of interest that under such conditions, where the plants are relatively sheltered and grow in a locally moist environment, they produce strongly thick-walled cells, with the cell-lumen almost guttulate; such plants also tend to have the leaf-lobes barely obtuse or rounded. They correspond closely to the type of *C. arctica* (based on *C. verrucosa*). By contrast, plants growing in full sun are purplish-black and in general have thin-walled cells and acute leaf-lobes. Plants of this type correspond to *C. alpina*. It seems very probable that these are the two environmental extremes of a closely allied series of genotypes and do not deserve taxonomic recognition. This viewpoint is the more certain since in Schuster 35167 all kinds of intergrades can be found between typical *C. alpina* and typical *C. arctica*.



The above reports are not the first for Ellesmere Island. Bryhn (1906)—not Jensen (1906) as Frye & Clark (loc. cit., p. 551) indicate—reported it from central and southern Ellesmere Island. Jensen (1906)—not Bryhn (1906) as Frye & Clark (loc. cit., p. 551) indicate—reported the plant from the E. Greenland coast. However, not until after Douin (1920) was this plant well understood, and indeed it is hardly so today, so that these early reports demand verification.<sup>1</sup> Douin criticized Müller (1905–1916) for regarding the plant as dioecious; it is not correct to state, however, as did Frye & Clark (loc. cit., p. 549) that the plant of Douin is not that of K. Müller. Müller clearly labelled his illustrations as based on the type! Indeed, it is ironic that after stating that the plant called *C. grimsulana* by Müller does not belong to that species, they nevertheless copy his figures of the plant he considers to be *C. grimsulana*! All of this hardly serves to clarify our concepts of *C. grimsulana*, nor does the discussion in Joergensen (1934) aid in any way.

The above plants are referred to *C. grimsulana* because of (a) obviously autöcious inflorescences; (b) blackish-purple colour, or at least, in shade forms, with ruby-red coloration of the leaf-lobes; (c) small underleaves, which are at times hardly perceptible and appear locally lacking; (d) large, ruby-red to vinaceous-red gemmae, up to  $12$  to  $14 \times 20 \mu$  or more in size; (e) large leaf-cells, usually  $13.5$  to  $15 \mu$  wide at the bases of the lobes, rarely to  $16 \mu$ . Unfortunately, in some cases, these distinctions tend to vanish, and it becomes difficult to separate the plants from *C. arctica*. Dr. S. Arnell, to whom several of the collections above were sent, expressed the opinion that the plants might be *C. arctica*. The large cells, particularly of the gemmae, appear to preclude this. It is not impossible, however, that a large-celled polyploid variant of *C. arctica* is at hand, parallel to the var. *grandiretis* of *Tritomaria quinquedentata*. If such is the case then the separation of a species, *C. grimsulana*, becomes virtually impossible. Müller (1951–1958, pp. 1021–1022) would restrict *C. arctica* to "Silikatunterlage," which is certainly incorrect; indeed I wonder if he understood this species. However, he separates *C. grimsulana* from *C. arctica* on the basis of the larger cells " $14$  to  $16 \mu$ ," and the occurrence "in schwärzlichen Rasen im Hochgebirge," and correctly states (p. 1036) that *C. arctica* differs from *C. grimsulana* in the "kleinere Zellen." If the latter criterion is considered to be the most salient, the plants above must be regarded as *C. grimsulana*.

The material from Hilgard Bay occurred in a relatively small area where bed-rock was exposed by the action of a small stream, in sheltered, damp crevices. Closely associated were *Scapania lapponica*, *Lophozia excisa*, *Solenostoma polaris*, and the mosses *Mielichhoferia mielichhoferiana*, *Hygrohypnum alpestre*, *Grimmia alpestris*, *Philonotis fontana*, *Timmia norvegica*, and *Holmgrenia chrysea*. Material from a similar site in a nearby small ravine (35911, 35911a) is more doubtful, although autöcious and with gemmae to  $12$  to  $14 \times 20 \mu$ . It was associated with *Gymnomitrium corallioides*, *Scapania lapponica*, *Mielichhoferia*, *Grimmia apocarpa*, *G. alpestris*, *Hypnum cupressiforme*, and *Didymodon rufus*.

<sup>1</sup>The plant reported from the United States as "*C. grimsulana* var. *angustiloba*" by Frye & Clark (loc. cit., p. 551) has nothing to do with the *Cephaloziella angustiloba* reported by Douin (1920) from the "Etats-Unis." This latter plant is presumably a variant of *C. subdentata* (Schuster, 1953).



### 37. *Cephaloziella byssacea* (Roth) Wstf.

Purplish-black-tinged filaments, among mosses, moist humus on snow-fed scree slope, 2,000 to 2,400 feet, E. edge of U.S. Range, ca. 9 to 10 miles due W. of Peak 1 (35576a, 35576b). Scattered among mosses, open snow-fed scree slope, ca. 2,000 feet, 6 to 9 miles NW. of Peak 1, toward middle Wood Creek Valley, E. of main body of U.S. Range (35555).

Although *C. byssacea* has been widely reported from the Arctic, the species appears to be rare or lacking in almost all calcareous portions of the Arctic; the species is almost constantly strongly oxylophytic, being associated with, most often, *Polytrichum* and *Sphagnum*, occasionally the less lime-tolerant *Dicrana* or the oxylophytic *Leucobrya*. The local plants are associated with *Hylocomium splendens*, *Polytrichum alpinum*, *Timmia austriaca*, *Tortula ruralis*, *Pohlia cruda*, and *Drepanocladus uncinatus*; they can be placed only questionably in *C. byssacea*.

The plants of this collection are critical and sparse. Only male shoots were found, indicating dioecism (and thus apparently eliminating the often very similar *C. arctica*). The most robust plants were larger than any *C. arctica* seen with the leaf-lobes 10 to 12 cells broad at base and somewhat folded over each other, as is characteristic of mature *C. byssacea*. Large, often bifid underleaves were present. I have referred these collections to *C. byssacea*, albeit questionably so, because I could not demonstrate a monœcious inflorescence. Dr. S. Arnell, who examined them, expressed the opinion they might be *C. arctica*.

## ODONTOSCHISMACEAE

### ODONTOSCHISMA Dumort.

### 38. *Odontoschisma macounii* (Aust.) Underw.

Over basic humus, weathered rubble at foot of Mt. Pullen, mossy slope below persisting snowbank (35104). Damp, weakly basic humus, over shale slope below persisting snowfield, The Dean (35156b, 35156g). Over snow-fed, moist peaty humus, over weathered calcareous slopes, Mt. Pullen (35306, 35306a, 35325, 35325a). In pure green patches, over basic, wet humus, lying over snow-fed, calcareous slopes, E. face of Mt. Pullen (35333, 35337). Northernmost extension of the range.

In the Alert area, where the species is very rare and is confined to calcareous areas, the species occurs largely over humus, over calcareous clay and shale slopes irrigated by "hanging" snowbanks. Associated are a series of hepatics, including most often *Anthelia juratzkana*, *Cephaloziella arctica*, *Tritomaria heterophylla*, *T. quinquedentata*, *Lophozia alpestris* var. *major*, *L. heterocolpa*, *L. quadriloba*, *Cryptocolea imbricata*, *Gymnomitrium concinnum*, *Scapania polaris*, *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, and rarely *Lophozia opacifolia*. Associated mosses include *Fissidens arcticus*, *Timmia austriaca*, *Didymodon recurvirostris*, *Hypnum cupressiforme*, *Pohlia cruda*, *Bryum capillare*, *Barbula icmadophila*, *Isopterygium pulchellum*, *Mnium hymenophyllum*, *Holmgrenia chrysea*, *Ditrichum flexicaule*, *Philonotis fontana*, and *Myurella julacea*.



The species occurs as scattered plants, or forms small, conspicuous, pale yellow-green tufts. It has not been reported north of central and southern Ellesmere Island (Bryhn, 1906); I have seen plants from near Thule, Greenland. In Europe it occurs from Spitsbergen southward to northern Scandinavia, with relict stations in the Alps.

## Order METZGERIALES

### PALLAVICINIACEAE

MOERKIA Gottsche *in* Gottsche & Rabenh.<sup>1</sup>

#### 39. *Moerkia flotowiana* (Nees) Schiffn.

Damp, calcareous clay slope below persistent snowbank, 2 miles W. from tip of Cape Belknap, along shore of Lincoln Sea, lat. 82°32' N., long. 62°30' W. (35817, *p.p.*). Associated are *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Cephaloziella arctica*, *Lophozia pellucida minor*, and such angiosperms as *Saxifraga oppositifolia*, *S. caespitosa*, and *Salix arctica*.

This collection represents a major extension northward of the species, genus, and family (from *ca.* 69°N.). The plant has been heretofore unknown from the North American Arctic, although reported from several stations in and near the tundra in northern Europe (Troms District, Norway, southward) and Asia (eastern Siberia).

The present collection is of great interest in that it represents a highly derivative, strongly adaptive modification of the species. The plants are unusually small (both mature male and female plants merely 2.5 to 4 mm wide), clearly demonstrating that size, *per se*, is quite unreliable as a distinction between *M. flotowiana* and *M. hibernica*, as has been previously emphasized (Schuster, 1949), although Müller (1951–1958) still lays considerable emphasis on this as a differential feature. However, in the present plants, reduction in size appears confined to the thallus-wings, or lamina, since the costa is exceptionally well developed and commonly fully one-third the total width of the thallus. Furthermore, the thallus shows, in cross-section, a costa with the traditional features of *M. flotowiana*: a flat-bottomed, somewhat obtuse-trapezoidal cross-section, with nearly vertical flanks. The thallus is medially broadly sulcate, with the wings usually strongly ascending. The costa varies from 1,100  $\mu$  wide  $\times$  800  $\mu$  high (along the midline) to 1,250  $\mu$  wide  $\times$  720  $\mu$  high; it ranges from 22 to 26 cells high in the cases examined. Furthermore, the brownish-coloured, lateral "conducting strands" are quite distinct in mature portions of the thalli. Unlike the allied *Pallavicinia lyellii*, their cells are scarcely differentiated (as seen in cross-section), except for the brownish walls. The diameter of the cells in the strands averages *ca.* 25 to 40 (45)  $\mu$ , exactly as in the other interior cells of the axis.

The ascending and very strongly fluted thallus wings in the plants of this collection are unusually rigid—much more so than in the flaccid *M. hibernica*—and on their margins commonly somewhat fuscous-purple-tinged,

<sup>1</sup>Regarding the spelling *Moerckia* vs. *Moerkia* see Schuster (1958c). Arnell (1956) spells it *Moerchia*.



associated with the insulated and exposed site at which the plants grew. The narrow thallus width is, therefore, in part due to the strongly erect, rather than patent, wings of the thallus. The cells in the unistratose, lateral portions of the lamina are commonly nearly subquadrate, averaging (23 to 24) 25 to 30 (32 to 35)  $\mu$  in diameter; those on the very margins are often slightly larger, averaging 26 to 42  $\mu$ . The cells have numerous minute oil-bodies, previously undescribed, ranging from  $1.8 \times 2.5$  to  $3 \times 2 \times 4 \mu$ , occasionally broad ovoid or spherical ones ranging to 3 to 4  $\mu$ . They are formed of discrete, although usually barely perceptible spherules which scarcely protrude through the common bounding membrane. On an average the intramarginal laminar cells have 18 to 30, occasionally to 40 to 50 oil-bodies per cell.

On the female plants the gynœcia are often crowded, associated with the narrowed and foreshortened aspect of the plants. As a consequence, the lacinate scales peripheral to the perichaetia may become contiguous, from one perichaetium to the next. Thus a facies approaching that of *M. blyttii* may be attained. However, the colourless rhizoids and the contorted and undulate thalli, with the characteristically flat-bottomed costae, clearly eliminate this last species from consideration. The somewhat plicate and rather firm perichaetia may be 1 to 1.5 mm in diameter and 3 to 4.5 mm high. Their apices are somewhat fuscous-tinged and ciliolate to ciliate; the longer cilia are 2 to 5 cells long and often curled inward; their cells are *ca.* 25  $\mu$  in diameter  $\times$  55 to 70  $\mu$  long and extremely delicate. The lacinate and ciliate-margined scales at the base of the perichaetia are quite similarly fringed.

## ANEURACEAE

### TRICHOSTYLIUM Corda

#### 40. *Trichostylium pinguis* (L.) Schust.

Moist, calcareous, clay-shale solifluction slope below persistent snow-bank, 2.5 miles W. of Cape Belknap, S. of Williams Island (35201, 35207). Wet, calcareous, clay-shale solifluction slope, head of Parr Inlet (35142, 35142b, 35145, 35145a, 35151). Damp, calcareous slopes, S. end of Hilgard Bay (35235a, 35238, 35238a). Damp, calcareous clay slopes, near shore of Dumbbell Bay (35293, 35296c). Moist, moss-tundra flat outwash plain NE. of Mt. Pullen (35381, 35382).

This cosmopolitan, variable species is found from the tropics evidently as far north as there is intermittently exposed land. After becoming familiar with the species in the field, as far south as central Florida, where the plant is found on logs lying in cabbage-palm dominated evergreen forest, it seemed at first almost impossible that the plants collected near Alert could represent the same taxon. Yet, morphologically at least, there appears no basis for considering these collections as other than normal *Trichostylium pinguis*! The local collections are habitually sterile. As is often the case to the south, the local collections came from decidedly calcareous sites: unstable, snow-fed, clayey slopes, on which a rather close moss-tundra had developed. At Colan Bay *Equisetum variegatum*, a species occurring again with *Trichostylium* as far south as central New York (Schuster, 1949), was associated. The wet slopes where the *Trichostylium* occurred also were a typical habitat for the mosses *Drepanocladus revolvens*, *Holmgrenia*



*chrysea*, *Philonotis fontana*, *Cinclidium arcticum*, *Barbula icmadophila*, *Catoscopium nigratum*, *Distichium capillaceum*, *Hypnum bambergeri*, and *Campylium stellatum*. Associated hepatics were typically *Lophozia gillmani*, less often *L. badensis*, *L. muelleri*, *L. alpestris* var. *major*, *L. pellucida*, *L. quadriloba*, *Cryptocolea imbricata*, *Athalamia hyalina*, *Solenostoma polaris*, *Preissia quadrata*, and rarely *Arnellia fennica* and *Lophozia hyperarctica*. The *Trichostylium* usually occurred as a minor admixture.

## Order MARCHANTIALES

### CLEVEACEAE (= SAUTERIAACEAE)

#### SAUTERIA Nees

#### 41. *Sauteria alpina* Nees

Wet, calcareous, clay-shale solifluction slope, head of Parr Inlet (35142d). Scattered plants on damp, highly calcareous clay-shale polygon slope, S. end of Parr Inlet (35681). Moist, heaved, calcareous, clay-shale solifluction slope, fed by persistent snowbank, Cape Belknap, on shore of Dumbbell Bay (35281, 35281a). In whitish-green patches on bare, calcareous clay, head of Parr Inlet (35474). On the edge of the frozen Lincoln Sea, polar ice-cap, just above the beach, on damp, clay-shale solifluction slope, northernmost station (35826).

The present reports appear to represent the northernmost ones for the genus and species. *Sauteria alpina* is not infrequent in the Alert area, always at lower elevations on exposed clay-shale slopes near the edge of the polar sea. It usually occurs as scattered plants, often associated with the superficially similar *Athalamia hyalina*; from the latter it is distinguishable at a glance by the bisexual, pale green thalli with whitish thallus margins, and by the flatter, more shallowly lobed carpocephala. In the Alert area mature spores could be found from July 17 to August 18. However, the carpocephala found July 17 were those produced during the preceding season, which were evidently snow-covered before full maturation. As a consequence, the carpocephala formed during one year may, evidently, not release their spores until a year later. The carpocephala found with mature spores on August 18, however, were formed during the present season.

*Sauteria* occurs chiefly on calcareous shale-clay solifluction slopes and on shaly, damp, polygon fields. Associated are usually *Athalamia hyalina*, *Preissia quadrata*, *Solenostoma polaris*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Trichostylium pinguis*, and rarely *Lophozia hyperarctica*. In such sites the angiosperms *Juncus biglumis*, *Eriophorum scheuchzeri*, *Alopecurus alpinus*, *Luzula nivalis*, *Saxifraga caespitosa*, *S. flagellaris*, *S. oppositifolia* commonly occur.

#### ATHALAMIA Falc.

#### 42. *Athalamia hyalina* (Sommerf.) Hattori (= *Clevea hyalina* (Sommerf.) Lindb.)

Damp clay at base of rocky outcrops, around a lemming-warren, above Parr Inlet (35080). Moist, calcareous, clay-shale slope beneath persistent snowbank, 2.5 miles W. of Cape Belknap, S. of Williams Island



(35201). Moist, heaved, calcareous clay-shale solifluction slope, fed by persistent snowbank, Cape Belknap, shore of Dumbbell Bay (35281a, 35281b, 35293). Moist clay slope, head of Parr Inlet (35473). Exposed clay-shale polygon field, base of Cape Belknap, N. of airstrip at Alert (35827). Moist tundra over clay-shale slope, between Dumbbell Bay and The Dean (35060). Moist depression, dry *Saxifraga caespitosa* slope (over shale talus), Dumbbell Bay, near Alert (35080). Basic, exposed soil, snow-fed slope below a shallow ravine, The Dean (35178).

*Athalamia hyalina*, found in the Alert area at the northernmost extension of its range, was more limited in distribution within the region than was *Sauteria alpina*. The two plants not infrequently occurred together, although rarely admixed. Where occurring together they could be immediately separated in the field by the generally cruciform carpocephala of the *Athalamia*, those of the *Sauteria* being more discoid, with usually 5 to 7 short, somewhat flattened "arms."<sup>1</sup>

Although *Athalamia* in shaded sites tends to be a rather crystalline, greyish-green (Schuster, 1953), in the exposed sites in which it occurred in northern Ellesmere Island, the plants were almost constantly strongly pigmented. This was particularly the case with the carpocephala. In shaded sites these are usually a rather translucent, pure yellowish-green, contrasted to the greyish-green thallus; in the Alert area the carpocephala were highly pigmented: the carpocephala were blood-red, the thalli purplish, the spores orange-red. By contrast, *Sauteria alpina*, growing under identical environmental conditions, remained devoid of secondary pigmentation.

*Athalamia hyalina* locally is found over clayey, calcareous polygon soil, on rocky, clay-shale slopes (often in slight run-off crevices in Saxifrage barrens) and on solifluction slopes. Associated, usually, are *Arnellia fennica*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Solenostoma polaris*, *Scapania gymnostomophila*, *Trichostylium pinguis*, *Preissia quadrata*, *Lophozia alpestris major*, *Lophozia badensis*, and a variety of mosses (*Encalypta alpina*, *E. procera*, *Amblystegiella sprucei*, *Tortula ruralis*, *Barbula icmadophila*, *Anoetangium tenuinerve*, *Holmgrenia chrysea*, *Ditrichum flexicaule*, *Timmia norvegica*, *Fissidens arcticus*, *Didymodon recurvirostris*, *Holmgrenia stricta*, *Mnium hymenophyllum*, *Aloina brevirostris*, *Mnium orthorhynchum*, *Myurella tenerrima*, *Cirriphyllum cirrosum*). Mature spores are produced much later than in Minnesota, where they are developed in May (Schuster, 1953); they were first found on August 18. Occasionally the plant is found in sites that are early snow-free, the first plants being found June 3, some days before the "snow-melt" became pronounced.

## MARCHANTIACEAE

### PREISSIA Corda

#### 43. *Preissia quadrata* (Scop.) Nees

Over calcareous clay-shale slope, snow-fed, in *Saxifraga oppositifolia*-*Salix arctica*-moss "heath," Dumbbell Bay, near Alert (35083). Wet,

<sup>1</sup>This distinction is, at times, bridged. In 35178, a pigmented form of the *Athalamia*, there were a few 5 to 6 lobed carpocephala, and in 35473, again a phase with pigmented carpocephala, these possessed mostly 4 to 5 rays. The evident tendency for development of more than a maximum of 4 rays is notable in view of the fact that in very abundant Minnesota material (Schuster, 1953), not a single instance could be found where the carpocephala were not fundamentally cruciate.



calcareous, clay-shale solifluction slope, head of Parr Inlet (35142d). Moist, basic soil, snow-fed slope below a shallow ravine, The Dean (35178a). Wet, calcareous clay-shale slope below persisting snowfield, 2.5 miles W. of Cape Belknap, on edge of polar ice-cap, S. of Williams Island (35208, 35209). Moist, calcareous slope below persistent snowfield, S. end of Hilgard Bay (35244). Moist, heaved, calcareous clay-shale solifluction slope, fed by persistent snowbank, Cape Belknap, on shore of Dumbbell Bay (35281a, 35281b, 35289 [=35281c]). Moist, calcareous soil, edge of high cliff on SE. side of Hilgard Bay (35511).

*Preissia quadrata*, although locally not infrequent, appeared to be confined to the more calcareous lower slopes in the Alert region; it does not appear to have been previously reported from north of central Ellesmere Island. Bisexual plants were found, as well as an occasional gynandromorphous receptacle. Associated locally were *Athalamia hyalina*, *Sauteria alpina*, *Blepharostoma trichophyllum* ssp. *brevirete*, *Lophozia pellucida*, *L. hyperarctica*, *L. muelleri*, *Trichostylium pinguis*, *Solenostoma polaris*, *Arnellia fennica*, and *Scapania gymnostomophila*. As is the case with *Sauteria*, the plants found early in the season (i.e., before August 1), either were without spores, or were releasing spores from carpocephala that underwent their development during the preceding year. For example, the plants of Schuster 35244, collected July 5, possessed mature spores, just being shed, from the previous season's carpocephala. With the exceedingly short growing season, terminated by permanent snow cover as early as mid- or late August, the few regional Marchantiaceae are often apparently "caught" with their spores still somewhat immature and not ready to be released. Thus, even though these species may be "spring fruiting" locally, as they are farther south, such June and July release of spores is from old carpocephala. If spore release occurs at all from carpocephala of the present season's development, it occurs in early to late August.

The plants of *Preissia* from the Alert area do not conform closely to those from near the southern edge of their range, e.g., to those illustrated in Schuster (1953). The northernmost plants differ in being clearly bisexual, rather than unisexual, and in the hyaline, somewhat chartaceous and thin margins of the receptacles. Such pellucid, nitid, receptacular margins apparently never occur in the plants from less arctic environments. It is possible that this variable widespread species should be split into two or more species.



## II. MUSCI

WILLIAM CAMPBELL STEERE<sup>1</sup>

Thanks to man's insatiable curiosity and persistence in exploring the unknown, the plants of Ellesmere Island, the northernmost island in the Canadian Arctic Archipelago, have received much more attention than might be suspected at first thought. The more important earlier collections of mosses made on Ellesmere Island resulted from the activities of the British Arctic Expedition of 1875-76, under the command of Captain G. S. Nares (Mitten, 1878); and from the several attempts by Peary to reach the North Pole, attempts finally crowned with success (Bryhn, 1908; Williams, 1918), and of the second "*Fram*" Expedition, 1898-1902 (Bryhn, 1907).

Between the turn of the century, when Herman Simmons, botanist of the "*Fram*" expedition, was making his monumental collections, and 1955, when Ellesmere Island was first visited by a trained bryologist, the mosses of this island received only scant and rather desultory attention. In 1928, Gunnar Seidenfaden, and in 1936, both Nicholas Polunin and Père Arthème Dutilly collected bryophytes at Craig Harbour, at the southern end of Ellesmere Island (Harmsen and Seidenfaden, 1932; Steere, 1941, 1948). Holmen (1953) reported upon an interesting collection made in 1952 by J. C. Troelsen at Slidre Fiord, on the west coast of central Ellesmere Island. A few further specimens of bryophytes, brought back from Ellesmere by Canadian botanists working under the auspices of either the National Museum of Canada or the Canadian Department of Agriculture, are deposited in the herbaria of those two institutions in Ottawa.

Although a few casual collections of mosses from Alert are in the National Museum of Canada, Schuster's collection is the first made there by a professional bryologist—or anywhere else in the Canadian Arctic Archipelago, for that matter. As a consequence of Schuster's extraordinary zeal, extensive field experience, and trained eye, his collection reported upon here adds greatly and significantly to our knowledge of the distribution of mosses in the northernmost extensions of North America and to the vegetation and ecology of the very highest latitudes in arctic America. After studying this comprehensive collection, I am reasonably sure that very few species of mosses still remain undiscovered in the vicinity of Alert.

### FISSIDENTACEAE

#### 1. *Fissidens arcticus* Bryhn

In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous; W. and NW. slopes of The Dean (35156d). On moist calcareous moss-tundra and rocky clay slopes, W. slope near base, The Dean (35411). On moist gravelly and clayey slope at edge of Arctic Ocean (35821; \*35827a, c.fr.). On moist calcareous low flats, Parr Inlet (35937a).

<sup>1</sup>New York Botanical Garden.



This elegant but diminutive species was described by Bryhn (1907) from Ellesmere Island from several widely separated regions. Since then, it has been reported from Clavering Ø, West Greenland (Hesselbo, 1948), and has been found in abundance in arctic Alaska. The present collections are apparently the northernmost as yet known.

**2. *Fissidens viridulus* (Web. & Mohr) Wahlenb.**

On slope, 3 to 4 miles W. of Peak 1 (35704).

Widely distributed in the northern United States, and previously reported from two localities on Ellesmere Island (Bryhn, 1907; Steere, 1948). This collection represents the northernmost station reported so far.

DITRICHACEAE

**3. *Ceratodon purpureus* (Hedw.) Brid.**

On moist, calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35404). On loose scree, SW. slopes of Mt. Pullen, and near summit (35782a, \*35782g, 35788, 35796).

A cosmopolitan weedy species occurring in all parts of the world, this moss has been reported from the high N. latitude of 83°06', at Low Point on the north coast of Greenland (Hesselbo, 1923).

**4. *Distichium capillaceum* (Hedw.) BSG.**

On dry, eroded saxifrage barrens where snow cover is slight or non-existent, within one mile of Alert (35050a; \*35050f, c.fr.; 35060b; 35067; \*35069, c.fr.). In clay-shale barrens with shallow pools, SW. of Alert (35077, 35077a, 35078, 35079, 35079a, 35093, 35097, 35098, 35099). On local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, N. slope of Mt. Pullen (35119, 35122b, 35123a, 35125). On snow-fed solifluction, rich moss-tundra slope, head of Parr Inlet, Dumbbell Bay (35148a). In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks; calcareous, W. and NW. slopes of The Dean (35167; 35167n, c.fr.; \*35179a). On clayey and calcareous solifluction slope, two-fifths mile W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35207a, 35213a). On calcareous clay-shale slope, S. end of Hilgard Bay (Camp ravine), 12 to 15 miles SW. of Alert, (\*35249, c.fr.). On calcareous clay-shale, damp moss-tundra, Cape Belknap (\*35290, c.fr.). On rocky, steeply sloping, weakly or hardly calcareous scree-slopes, E. slope of Mt. Pullen (35311, 35330). On low scarp, edge of persistent snowfield, calcareous, permafrost 2 to 4 inches below surface, a quarter-mile N. of Mt. Pullen (35361\*, 35368c, 35371a). On calcareous shallow slope, stony outwash plain draining into Ravine Bay, half a mile N. of Mt. Pullen (35382b). On moist, calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411, 35418, 35420, 35421). In shade, on rotting rock-outcrop, not strongly calcareous, mouth of ravine on S. side of Hilgard Bay (35486b). On rocky, clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35529; 35534, c.fr., \*35535, 35540, 35543a, 35548c). On scree slope, 9 to 10 miles W. of Peak 1, toward

\*Indicates primary or dominant species in a collection number; others vary from important admixtures to very minor traces.



U.S. Range, ca. 2,000 to 3,000 feet (\*35560, c.fr.; 35562, 35571a, 35586b, 35588, 35601, 35602). On slope, 3 to 4 miles W. of Peak 1 (35706a). On scree slope, hill SW. of Mt. Pullen (35731b, 35733b, 35734b). On loose scree, SW. slopes of Mt. Pullen, and near summit (35761a, 35766). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822, 35827a). On clayey calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35866, 35877). At Camp Ravine, Hilgard Bay (35927a, 35928, 35931c).

Although not strictly a weedy species, this is one of the most common and abundant in arctic regions. It is also widespread in the boreal and temperate parts of the Northern Hemisphere and is surprisingly frequent in the Southern Hemisphere in the cooler climates. It reaches higher latitudes than those reported here at Low Point in northernmost Greenland (Hesselbo, 1923).

##### 5. *Distichium inclinatum* (Hedw.) BSG.

Clay-shale barrens with shallow pools, SW. of station, Alert (35081, c.fr.; 35094, c.fr.). Camp Ravine, Hilgard Bay (35930, c.fr.). On moist calcareous low flats, (35937, c.fr.).

Much less common than the preceding species and usually less abundant when it does occur; generally in moister habitats.

##### 6. *Ditrichum flexicaule* (Schwaegr.) Hampe

On dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35050a, 35050f, 35051a, 35060b, 35065, 35067, 35068, 35069a). On clay-shale barrens with shallow pools, SW. of station, Alert (35072, 35074, 35075, 35076, 35077, 35077a, 35078, 35079, 35080, 35081, 35091, 35097, 35098). On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt. Local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35110, 35122b, 35123a, 35125, 35128, 35129b). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144, \*35145, 35148a). On rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks; calcareous, W. and NW. slopes of The Dean (35167, 35167b). S. of Williams Island, 2.5 miles W. of Cape Belknap, on a snow-fed slope, just E. of Colan Bay; calcareous and clayey solifluction slope (35211, 35213a). On calcareous clay-shale slope, 12 to 15 miles SW. of Alert, S. end of Hilgard Bay at Camp Ravine (35249). On clay-shale, damp moss-tundra; calcareous, Cape Belknap (35287). On rocky, steeply sloping, weakly or hardly calcareous scree-slopes, E. slope of Mt. Pullen (35328a, 35330, 35348, 35350). On low scarp, edge of persistent snowfield, permafrost 2 to 4 inches below surface, one-quarter mile N. of Mt. Pullen (35361, 35362a, 35368c, \*35371, \*35371a). On calcareous shallow slope, draining into Ravine Bay, stony outwash plain, half a mile N. of Mt. Pullen (35382b). On moist, calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411, 35414, 35418, 35419, 35420, 35421). On rocky, clayey moss-tundra, on unstable slopes (35532, 35536, 35542, \*35545, 35548c). On dry, calcareous, unincorporated scree, scree slope 4 to 5 miles W. of Peak 1 (35551a). On scree slope 9 to 10 miles W.



of Peak 1, 2,000 to 3,000 feet alt. (35571a, \*35586b, 35601, 35602). On slope, 3 to 4 miles W. of Peak 1 (35704, 35706a). On scree slope, hill SW. of Mt. Pullen (35733b, 35734b). On loose scree, SW. slopes of Mt. Pullen and near summit (35761a, 35766, 35774, \*35782, 35782a, 35782b, 35782f, \*35785, 35787, 35788, 35789, 35794, 35796). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35818, 35827a). On clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35873, 35877). On moist calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (3588a). On noncalcareous rotting schist and slate ledges, deep ravine, S. side Hilgard Bay (35911d). At Camp Ravine, Hilgard Bay (35927a, 35928, 35931c, 35932).

Like *Distichium capillaceum*, this is one of the most widely distributed, abundant mosses in arctic and subarctic regions; also known in the Southern Hemisphere. This species seems peculiarly insensitive to such environmental conditions as degree of exposure, range of pH, amount of moisture, etc. and so is found in most habitats, except actually in permanently standing water and on exposed hard rock.

#### DICRANACEAE

##### 7. *Arctoa anderssonii* Wich. (*A. fulvella anderssonii* (Wich.) Grout)

On loose scree, SW. slopes of Mt. Pullen and near summit (35758, 35758a).

A rare arctic species known from northernmost Europe, arctic North America and from Greenland. Apparently new to Ellesmere Island.

##### 8. *Dicranella crispa* (Hedw.) Schimp.

On moist noncalcareous moss-tundra and rocky clay slopes, W. slope of The Dean (\*35401d, c.fr.). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35827a).

This appears to be a new record for the Canadian Eastern Arctic (Steere, 1948), as well as for the area under consideration. However, the problem may be one of identification instead of actual geographical distribution, as I have often wondered what Bryhn's report (1907) of *Dicranella heteromalla* from southern Ellesmere Island really represented—and this is a problem that should be settled promptly. I have collected this species rather widely in arctic Alaska and in northern Canada, and so am not at all surprised by its presence in Schuster's collection.

##### 9. *Dichodontium pellucidum* (Hedw.) Schimp.

In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167b). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen (\*35311). Moist noncalcareous moss-tundra on rocky clay slopes, W. slope of The Dean near base (35411). On moist calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35893).

Although often locally abundant, this is not a common species. However, it is widely distributed throughout boreal and arctic regions.



**10. *Dicranoweisia crispula* (Hedw.) Lindb.**

On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen (35309, \*35317a, 35327, 35350). In moist non-calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near Base (35421). On scree slope, probably acidic, 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35611b). On loose scree, SW. slopes of Mt. Pullen and near summit (35761, 35764, 35764b, 35765a, 35768a, \*35768b).

This species is widely distributed, especially in sterile, noncalcareous areas, throughout arctic regions, and was reported from northernmost Ellesmere Island over 75 years ago (Mitten, 1878).

**11. *Dicranum fuscescens* Turn.**

On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35118b). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, Mt. Pullen and vicinity; on E. slope (35318b, 35350). On moist noncalcareous moss-tundra and rocky clay slopes, W. slope of The Dean, near base (\*35425).

A very common and variable species of boreal and arctic regions, including northernmost Ellesmere Island.

**12. *Dicranum majus* Turn.**

On rocky, steeply sloping, weakly or hardly calcareous scree slopes, Mt. Pullen and vicinity, on E. slope (35313b). On low scarp, edge of persistent snowfield, calcareous, permafrost 2 to 4 inches below surface, a quarter mile N. of Mt. Pullen (35365a). On moist calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (\*35421, \*35425).

A common and extremely variable species especially common in boreal regions but extending into all arctic regions.

**13. *Dicranum scoparium* Hedw.**

On rocky, steeply sloping, weakly or hardly calcareous scree slopes, Mt. Pullen and vicinity, on E. slope (\*35327).

A species even more widely distributed, common, and abundant in boreal regions than the preceding, and yet not a truly weedy moss. It has apparently not been reported previously from Ellesmere Island.

**14. *Bryobrittonia pellucida* Williams**

In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167b).

First described from the Yukon, this species has been placed systematically and found to have a much wider distribution in the American Arctic (Steere, 1953a). According to Persson (pers. comm. November 15, 1957) this species has been discovered recently in northernmost Europe, and, as predicted earlier, it will certainly be found eventually throughout arctic Asia.



## ENCALYPTACEAE

15. *Encalypta alpina* Smith

On dry, eroded saxifrage barrens where snow cover is slight or non-existent, within one mile of station, Alert (35051a, 35060b). In clay-shale barrens with shallow pools, SW. of station, Alert (35079a, 35080, 35097). On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt; locally moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35122b). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144, 35145, 35148a). In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks; calcareous, W. and NW. slopes of The Dean (35162, 35167, 35179a). On clayey, calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35211, *c.fr.*). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, Mt. Pullen and vicinity, on E. slope (35330, 35348). On low scarp, edge of persistent snowfield, permafrost 2 to 4 inches below surface, calcareous, a quarter mile N. of Mt. Pullen (35362a, 35371, 35371a). On moist calcareous moss-tundra and rocky clay slopes, The Dean, W. slope near base (35418, 35419, \*35420). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (\*35486b). In clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35529, 35532, \*35533, 35548c). On slope, 3 to 4 miles W. of Peak 1 (35706a). On loose scree, SW. slopes of Mt. Pullen (35734b). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35821, 35827a). On moist calcareous clay, Upper Dumbbell Lake, *ca.* 125 feet alt. (35882). On noncalcareous rotting schist and slate ledges, in deep ravine, S. side of Hilgard Bay (35911). In Camp Ravine, Hilgard Bay (35926, 35927a, 35928, 35930, 35931, 35932).

A relatively common arctic-alpine species, most generally sterile, but easily recognized by the flaring leaves, broadest in the middle. Many collections have been reported from the area under consideration (Bryhn, 1908).

16. *Encalypta procera* Bruch

On dry, eroded saxifrage barrens on wind-blown areas where snow cover is slight or nonexistent, one mile from station, Alert (35051a, 35060b). On clay-shale barrens with shallow pools, SW. of Station, Alert (35080, 35080a, 35081). On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35125). On moist, calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (35486). On clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35536, 35542). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, *ca.* 2,000 to 3,000 feet alt. (35571a, 35601). On loose scree, SW. slopes of Mt. Pullen and near summit (\*35782, 35788, 35789). On moist gravelly and clayey slope at edge of Arctic



Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35827a). In Camp Ravine, Hilgard Bay (35826, 35927a, 35928). On moist calcareous low flats (35937).

Like the preceding, the present species has a very wide boreal and arctic distribution and has been reported previously from Grant Land (Bryhn, 1908).

**17. *Encalypta rhabdocarpa* Schwaegr.**

On dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35066, *c.fr.*). In clay-shale barrens with shallow pools, SW. of station, Alert (35078 *c.fr.*). On scree slope, 9 to 10 miles W. of Peak 1, toward U.S. Range (35569, *c.fr.*; 35591, 35608a). On loose scree, SW. slopes of Mt. Pullen and near summit (35761, \*35787). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35818). In Camp Ravine, Hilgard Bay (35930).

A common circumboreal species already reported from northernmost Grant Land (Mitten, 1878).

POTTIACEAE

**18. *Aloina brevirostris* (Hook. & Grev.) Kindb.**

In clay-shale barrens with shallow pools, SW. of station, Alert (35080a). On loose scree, SW. slopes of Mt. Pullen, and near summit (35788, *c.fr.*). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35827a).

These collections confirm beyond doubt my reidentification (Steere, 1950) of Bryhn's report (1907) of *A. rigida* (Hedw.) Kindb. and establish a new "farthest north" for a widely distributed northern species.

**19. *Anoetangium tenuinerve* (Limpr.) Paris**

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station Alert (35050f, 35060b, 35065). In clay-shale barrens with shallow pools, SW. of station, Alert (35078, \*35079a, 35080, 35081, 35093). On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt; local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (\*35110). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks; calcareous, W. and NW. slopes of The Dean (35167). On clayey calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35211, 35213a). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35414). On clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35540). On scree slope, 9 to 10 miles W. of Peak 1, toward U.S. Range, *ca.* 2,000 to 3,000 feet alt. (35571a, 35601). On loose scree, SW. slopes of Mt. Pullen and near summit (35734b). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35827a). On clayey calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35873). In Camp Ravine, Hilgard Bay (35926, \*35928, 35931c, 35932). On moist calcareous low flats, Parr Inlet (35937).



In the mountains of central and eastern Europe, rare; reported from many parts of arctic America, including northern Ellesmere Island (Bryhn, 1907). Under the rigorous and highly exposed environments of the Alert region, this species assumes reduced forms, one of which exactly fits the description of *Gymnostomum laeve* Bryhn (Bryhn, 1907), which was put into its proper context by Györfy (1912).

## 20. *Barbula icmadophila* Schimp.

On dry, eroded saxifrage barrens, in wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35050a, 35050f, 35051a, 35060b, \*35065, 35066, 35067, 35068, 35069, 35069a). In clay-shale barrens with shallow pools, SW. of station, Alert (35074, 35075, 35076, \*35077, 35078, 35079, 35079a, 35080, 35081, 35085, 35097). On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt; local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35123a). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35145). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35159a, 35167, 35167b, 35179a). On clayey calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35207a). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On clay-shale, damp moss-tundra, calcareous, Cape Belknap (35285, 35287). On calcareous shallow slope draining into Ravine Bay, stony outwash plain half a mile N. of Mt. Pullen (35382b). Moist calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411). On rotting rock outcrop, not strongly calcareous, in shade, at mouth of ravine on S. side of Hilgard Bay (35486a). On firm moss-covered, stabilized, calcareous scree slope, cliff-face at S. end of Hilgard Bay (\*35512). On rocky, clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2, (35536, 35540, 35543a, 35548c). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35562, \*35569, 35571a, 35602, 35608a). On loose scree, SW. slopes of Mt. Pullen, and near summit (35734b, 35764a, 35782, 35782a, 35788, 35789). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35821, 35825, 35827a). On clayey, calcareous, low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35877). On moist calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35882). In Camp Ravine, Hilgard Bay (35926, 35927a, 35928, 35931c, 35932). On moist calcareous low flats, Parr inlet (35937a).

A widely distributed and surprisingly common species of boreal and arctic regions, even though not often reported in arctic North America. The reports of *Barbula rigidula* (Hedw.) Milde from the Canadian Eastern Arctic (Steere, 1948) may very well be based on this species.

## 21. *Desmatodon latifolius* (Hedw.) Brid.

On scree slope, 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35608a).

A widespread arctic-alpine species, apparently not previously reported from Ellesmere Island in its typical form.



**22. *Desmatodon leucostomus* (R. Brown) Berggr.**

On dry, eroded saxifrage barrens in wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (\*35066, c.fr.). In Camp Ravine, Hilgard Bay (\*35930, c.fr.).

A widely distributed arctic species which has been imperfectly understood because of the several concepts and interpretations that have been put upon it (Berggren, 1875; Steere, 1940, 1951).

**23. *Didymodon recurvirostris* (Hedw.) Jenn.**

In dry, eroded saxifrage barrens on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35066). In clay-shale barrens with shallow pools, SW. of station, Alert (35079a, 35081). On calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt; local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35116a). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35159a, 35167, 35167b). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35311, 35325a, 35348). On low scarp, edge of persistent snowfield, permafrost 2 to 4 inches below surface, calcareous, one-quarter mile N. of Mt. Pullen (35362a). In moist calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411, 35418, 35419). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (35486b). On clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35527, 35535, 35536, 35548c). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35608a). On loose scree, SW. slopes of Mt. Pullen, and near summit (35734b, 35782, 35787, 35788, 35789). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35821, 35827a). In Camp Ravine, Hilgard Bay (35926, 35927a, 35930, 35932, 35937).

A very common and abundant moss in moderately to strongly calcareous habitats throughout the arctic and boreal regions of the Northern Hemisphere and also reported from austral regions.

**23a. *Didymodon recurvirostris* (Hedw.) Jenn. var. *dentata* (Schimp.) C. Jens.**

In rocky, clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35529). On loose scree, SW. slopes of Mt. Pullen, and near summit (35766). On moist calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35893).

A large and reasonably distinct form of the species, especially in northern regions.

**24. *Didymodon rufus* Lor.**

On calcareous clayey solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35211). On clay-shale, damp moss-tundra, calcareous, Cape Belknap (35287). On scree slope, 9 to 10 miles W. of Peak 1, toward U.S. Range (35571a, 35601). On loose scree, SW. slopes of Mt. Pullen, and near summit (35788). On



moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822a,b; 35827a). On moist calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35893). On rotting schist and slate ledges, deep ravine on S. side of Hilgard Bay (35911). On moist calcareous low flats, Parr Inlet (35937a).

An arctic-alpine species of such wide ranges of variability that its geographic distribution is still very incompletely known. In its optimum development, this species approaches and equals *D. giganteus* (Funck) Jur. (already collected in arctic Alaska) in size, and in its smaller phases much resembles *Barbula icmadophila* Schimp.

**25. *Pottia obtusifolia* (R. Brown) C. Müll.**

On dry eroded saxifrage barrens, in wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (\*35069a, c.fr.). On loose scree, SW. slopes of Mt. Pullen, and near summit (35788, c.fr.).

A truly arctic species of Greenland and northernmost North America, that, although related to *P. heimii* (Hedw.) Fühnr., is separated from it by its chromosome number (Steere, 1955), as well as by more obvious and reasonably constant morphological characters.

**26. *Tortula mucronifolia* Schwaegr.**

On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (\*35486a, c.fr.). On slope, 3 to 4 miles W. of Peak 1 (35704). On loose scree, SW. slopes of Mt. Pullen and near summit (\*35782, \*35787, 35788, \*35789). On moist calcareous low flats, Parr Inlet (35937).

Although apparently common on Cornwallis Island (Steere, 1951) and on Prince Patrick Island (Steere, 1955), this species has not been often collected elsewhere in the Canadian Arctic Archipelago (Steere, 1948), and the present collection certainly represents the northernmost known station in North America.

**27. *Tortula norvegica* (Web. & Mohr) Wahlenb.**

On moist calcareous moss-tundra and rocky clay slopes, west slope of The Dean near base (35420).

Previously reported from Grant Land by Bryhn (1908); not common, but widely distributed in polar and boreal regions.

**28. *Tortula ruralis* (Hedw.) Smith**

On dry, eroded saxifrage barrens on wind-blown areas where snow-cover is slight or nonexistent, within one mile of station, Alert (35050a, 35060b, 35067, 35069a). Clay-shale barrens with shallow pools, SW. of station, Alert (\*35072, 35075, 35076, 35077, 35077a, 35078, 35097). On local, moist, relatively rich moss-tundra, exposed within ten days after start of snow-melt, calcareous shale-sandstone north slope of Mt. Pullen (35118b, 35128). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35148a). Rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167, 35167b, 35179a). On clay-shale,



damp moss-tundra, calcareous, Cape Belknap (35285, 35287). On rocky, steeply sloping, weakly or hardly calcareous scree-slopes, E. slope of Mt. Pullen and vicinity (35309, 35317a). On low scarp, edge of persistent snowfield, one quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35361, 35362a, 35371a). On moist calcareous moss-tundra and rocky clay slopes, west slope of The Dean near base (35414, 35422). On firm, moss-covered, calcareous, stabilized scree slope, cliff face at S. end of Hilgard Bay (35512). On rocky, clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (35538, \*35541). On dry noncalcareous, unincorporated scree slope 4 to 5 miles W. of Peak 1 (35555b). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35562, 35569, 35571a, 35582, 35583, 35586b, 35587, 35588, 35589, 35592, 35602, 35605, 35606, 35608a, 35611, 35611b). On slope, 3 to 4 miles W. of Peak 1 (35704). On loose scree, SW. slopes of Mt. Pullen and near summit (35733, \*35761a, c.fr.; 35761b, 35764, 35764a, 35767a, 35768, 35768a, 35768b, 35770, 35774, 35782a, 35782f, 35787, 35788). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35816, 35818). On noncalcareous, rotting schist and slate ledges, deep ravine, S. side of Hilgard Bay (35911d). Camp Ravine, Hilgard Bay (35928).

A widely distributed and abundant species of boreal and arctic regions; extremely tolerant of variations in such habitat conditions as pH, moisture, and exposure, and therefore extremely common. It has been reported previously from Grant Land by both Mitten (1878) and Bryhn (1908).

#### GRIMMIACEAE

##### 29. *Grimmia anodon* BSG.

On firm, moss-covered, calcareous, stabilized scree slope, cliff face at S. end of Hilgard Bay (\*35512, c.fr.). On moist, gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35816, c.fr.).

Although never a truly common species, this has a surprisingly wide geographical distribution in the Northern Hemisphere and has been reported from both Greenland and Ellesmere Island (Bryhn, 1907). These collections apparently represent the northernmost stations for the species.

##### 30. *Grimmia alpestris* Nees

On rotting rock-outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (\*35480, \*35481, \*35482, \*35484). On noncalcareous rotting schist and slate ledges, in deep ravine, S. side of Hilgard Bay (35911d, 35914b).

A rare but nevertheless widely distributed species in the Northern Hemisphere, known from Greenland, but not previously reported from the Canadian Arctic Archipelago.

##### 31. *Grimmia alpicola* Hedw.

In clay-shale barrens with shallow pools, SW. of station, Alert (\*35074, c.fr.). On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, in local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35128, c.fr.). On moist calcareous moss-tundra



and rocky clay slopes, west slope of The Dean near base (\*35414). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35581). On loose scree, SW. slopes of Mt. Pullen and near summit (\*35767a, \*35768, 35768b, \*35770b). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35816).

A very widely distributed species, but rarely abundant; known from Siberia and Greenland, but not previously reported from Ellesmere Island.

**31a. *Grimmia alpicola* Hedw. var. *latifolia* (Zett.) Möller**

On loose scree, SW. slopes of Mt. Pullen and near summit (35759, 35770, \*35770b). On noncalcareous, rotting schist and slate ledges, in deep ravine, S. side of Hilgard Bay (35914b).

This moss, which is rather distinctive and may well rate specific recognition, was described as a species, *G. platyphylla*, by Mitten (1865). This is more typically arctic in its distribution than *G. alpicola* and may perhaps be only a xerophytic form, although in its well-developed condition it is indeed distinctive.

**32. *Grimmia apocarpa* Hedw.**

On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, in local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35128). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (\*35318b, 35359). On moist, calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35422, \*35424). On rocky, clayey moss-tundra, on stable slopes, valley between Peak 1 and Peak 2 (\*35537). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (\*35551a). On scree slope 0 to 10 miles W. of Peak 2, toward U.S. Range (35581, \*35587, \*35591, 35592, 35608a, \*35611, \*35611b). On slope 3 to 4 miles W. of Peak 1 (\*35704). On loose scree, SW. slopes of Mt. Pullen and near summit (35761a, \*35761b, \*35764, 35764a, 35764b, \*35765, 35765a, \*35767a, \*35768, \*35768a, \*35770a, \*35774). On noncalcareous, rotting schist and slate ledges, in deep ravine on S. side of Hilgard Bay (35911d).

Although not truly weedy, this is one of the most common and widely distributed species of mosses, in higher latitudes and altitudes of both the Northern and Southern hemispheres. Nevertheless, these collections represent the northernmost stations in North America.

**33. *Grimmia gracilis* Schleich. in Schwaegr.**

On clay-shale, damp moss-tundra, calcareous, Cape Belknap (35285, c.fr.; \*35287, c.fr.). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (\*35583). On slope 3 to 4 miles W. of Peak 1 (\*35701).

A widely distributed arctic species, previously reported from the Canadian Arctic Archipelago, including Ellesmere Island (Bryhn, 1907; Steere, 1948), but not from so far north as the Alert region.

**34. *Grimmia tenuicaulis* Williams**

On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35590, 35611b). On loose scree, SW. slopes of Mt. Pullen and near summit (\*35763).



Originally described from the Yukon Territory of Canada, this species is now known from British Columbia, Alberta, Montana, and Wyoming, and I have collected it in arctic Alaska and at Great Bear Lake. This is a new record for the arctic Canadian Archipelago, however.

**35. *Grimmia torquata* Hornsch.**

On loose scree, SW. slopes of Mt. Pullen, and near summit (35761).

A relatively rare but widely distributed moss of the Northern Hemisphere, reported from Greenland, and from farther south in Ellesmere Island by Bryhn (1907).

**36. *Rhacomitrium canescens* (Hedw.) Brid.**

On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35317a, 35318b, 35327). On stable slopes, rocky, clayey moss-tundra, valley between Peak 1 and Peak 2 (\*35538). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1, (35551a). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35581, \*35595c). On slope, 3 to 4 miles W. of Peak 1 (\*35703, \*35704). On loose scree, SW. slopes of Mt. Pullen and near summit (35764, 35764a, 35770a).

A widely distributed circumboreal species, not uncommon in rather sterile arctic and alpine habitats.

**37. *Rhacomitrium lanuginosum* (Hedw.) Brid.**

On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, in local, moist, relatively rich moss-tundra (35118b, \*35130). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (\*35318b, 35350). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean, near base (\*35392b, 35398a, 35421). On dry, noncalcareous, scree slope 4 to 5 miles W. of Peak 1 (35551a). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35581, 35589, \*35592). On loose scree, SW. slopes of Mt. Pullen and near summit (\*35738b, \*35764a, 35765a, 35774).

One of the most widely distributed species over the whole world at high altitudes and high latitudes, in sterile and exposed habitats. In the Northern Hemisphere it reaches a northernmost latitude at 83°06' at Low Point, Greenland (Hesselbo, 1923) and is known from South Africa, South America, the Pacific Islands, and Australasia, in the Southern Hemisphere.

**38. *Rhacomitrium sudeticum* (Funck) BSG.**

On calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt on local, moist, relatively rich moss-tundra, N. slope of Mt. Pullen (35130). On loose scree, SW. slopes of Mt. Pullen and near summit (35738b).

These collections represent the first report for Ellesmere Island and the farthest northern stations for the species, which is widely distributed in boreal and arctic regions.



## SPLACHNACEAE

**39. *Haplodon wormskjoldii* (Hornem.) R. Brown**

In clay-shale barrens with shallow pools, SW. of station, Alert (35099). On not or hardly calcareous moss-tundra and rocky clay slopes (\*35402). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35596). On moist clay slopes, ca. 1 to 2 miles W. of tip of Cape Belknap, edge of Lincoln Sea (35637). On clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35868).

One of the most widely distributed and most typical of all arctic mosses; most common on the decomposing carcasses of animals, on owl pellets, on dung, and on other highly nitrogenous substrata. This species was previously reported from northernmost Ellesmere Island by Mitten (1878) and Bryhn (1908).

**40. *Tetraplodon mnioides* (Hedw.) BSG.**

In clay-shale barrens with shallow pools, SW. of station, Alert (35097). On moist, calcareous clay area, Upper Dumbbell Lake, ca. 125 feet alt. (35893).

On owl pellets, dung, and other highly nitrogenous substrata in arctic, subarctic, and high alpine areas throughout the Northern Hemisphere.

**41. *Tetraplodon paradoxus* (R. Br.) Hagen**

In moist calcareous clay area, Upper Dumbbell Lake, ca. 125 feet alt. (35883). On moist calcareous low flats, Parr Inlet (35937a).

On rich, nitrogenous substratum, probably the dung of musk-oxen; widespread in arctic regions. These collections are of interest, because they are both in association with *Voitia hyperborea* Grev. & Arn. and furnish confirmatory evidence that this "species" may be a hybrid between *Voitia* and *Tetraplodon mnioides* (Savicz, 1924).

**42. *Tetraplodon urceolatus* (Brid.) BSG.**

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (\*35067, c.fr.). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35341, c.fr.). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, 2,000 to 3,000 feet alt., (\*35593c). On moist clay slopes, ca. 1 to 2 miles W. of tip of Cape Belknap, edge of Lincoln Sea (35637). On loose scree, SW. slopes of Mt. Pullen and near summit (35794). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake.

A much reduced form, probably of *T. mnioides*; found in the most exposed and sterile areas on nitrogenous substrata throughout arctic regions but apparently was never either common nor abundant. Previously reported from northernmost Ellesmere Island by Mitten (1878).

**43. *Voitia hyperborea* Grev. & Arn.**

On moist calcareous clay, Upper Dumbbell Lake (\*35881, \*35883). On moist calcareous low flats, Parr Inlet (35937, \*35937a).



In exposed areas of the highest arctic areas, circumpolar, probably on the dung of the musk-ox. I have found this species in several localities in arctic Alaska, apparently its first discovery on the North American mainland (Steere, unpub. data).

## BRYACEAE

### 44. *Bryum arcticum* (R. Brown) BSG.

In clay-shale barrens with shallow pools, SW. of station, Alert (\*35085). In local, moist, relatively rich moss-tundra on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (\*35116a). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near the base (\*35405). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range ca. 2,000 to 3,000 feet alt. (\*35562). On moist calcareous low flats, Parr Inlet (35937, 35937a). All with sporophytes.

This species, originally described from Melville Island in the western part of the Canadian Arctic Archipelago, is now known to be widely distributed but was never common at high altitudes and high latitudes in boreal and arctic regions. It has been reported previously from Grant Land by Mitten (1878).

### 45. *Bryum argenteum* Hedw.

In dry, eroded saxifrage barrens, in wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35069a). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35782, 35788, 35789).

This species, probably one of the weediest of all mosses, is known throughout almost the whole world, in every continent and in nearly every climate. Nevertheless, the present collections may represent the northernmost station known for this species.

### 46. *Bryum calophyllum* R. Brown

On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (\*35149).

Originally described from Melville Island, in the western part of the Canadian Arctic Archipelago, this species is now known to be circumpolar in its distribution, although neither common nor abundant. It has been reported previously from northern Grant Land by both Mitten (1878) and Bryhn (1908). It apparently reaches its northernmost station at Low Point, Greenland, above 83° N. lat. (Hesselbo, 1923).

### 47. *Bryum capillare* Hedw.

In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35159a).

Although common and abundant throughout the world, in many forms and under many names, this species does not seem to have been reported previously, at least under this ancient name, from Ellesmere Island or from the Canadian Eastern Arctic (Bryhn, 1907; Steere, 1948).



48. *Bryum cryophilum* Märt. (*Bryum obtusifolium* Lindb., 1867; not *B. obtusifolium* Turner, 1804).

In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (35527). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35766). On clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35870). This is one of the commonest of all species of *Bryum* in the arctic tundra, especially in moist places; concerning its abundance in Ellesmere Island, Bryhn (1907) says: "Denne er en af de mest almindelig forekommende Arter, der uden Tvivl findes paa ethvert af de undersøgte Steder."

Bryhn (1908) later reported it from northernmost Grant Land.

49. *Bryum inclinatum* (Web. & Mohr) Sturm

In dry, eroded saxifrage barrens, in wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35051a). In clay-shale barrens with shallow pools, SW. of station, Alert (\*35085). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35562). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (\*35782, 35789).

Widespread in arctic regions around the pole, but apparently not common; reported previously from Ellesmere Island by Bryhn (1907).

50. *Mielichhoferia mielichhoferiana* (Funck) Limpr.

On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (\*35479, \*35483, 35911b, 35911d, 35912, 35913, 35914, 35914b, uniformly sterile).

This seems to be the first report of a rare arctic-alpine moss from northernmost Canada and only the second report from the Dominion. Crum (1956) reported the first known collection from Canada, from the north shore of Lake Superior, in Ontario. However, it is undoubtedly less rare than these collections would indicate. I have collected it in abundance and with sporophytes in arctic Alaska at Peters Lake in 1952. *Mielichhoferia macrocarpa* (Drumm.) Br. & Sch. has been reported from both Ellesmere Island and from Devon Island (cf. Steere, 1948). In spite of the careful studies of Bartram (1927) and of Andrews (1933, 1935) on the species of *Mielichhoferia* that occur in North America, further investigation of the species problem in this genus will be very rewarding as more and more material becomes available.

51. *Mniobryum albicans* (Wahlenb.) Limpr.

On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (\*35561).

As pointed out earlier (Steere, 1948), this is not a truly arctic species, and the present specimen represents a substantial northward extension of its geographical range in North America.

52. *Pohlia cruda* (Hedw.) Lindb.

On dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35065, 35068). In clay-shale barrens with shallow pools, SW. of station, Alert



(35079). In local, moist, relatively rich moss-tundra on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35116a, 35119, \*35123a, 35125, \*35129b, c.fr.); in rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slope of The Dean (35159a, 35162, 35167b, 35179a). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35314, 35315, 35325a, 35330, 35348). On low scarp, edge of persistent snowfield, calcareous, permafrost 2 to 4 inches below surface, one-quarter mile N. of Mt. Pullen (35361, 35362a). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean, near base (35398a, \*35399a, 35401d, 35404, 35405a, \*35411, 35419, 35420, 35421, 35425). On rocky, clayey moss-tundra on more or less stable slopes, valley between Peak 1 and Peak 2 (35529, 35542). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (35555b). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35588, 35593c, 35595c, 35602). On slope 3 to 4 miles W. of Peak 1 (35704, 35706a). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (\*35731b, 35733b, 35734b, 35761a, 35766, 35782b, 35782f, \*35796). On moist calcareous low flats, Parr Inlet (35937a).

A common and often abundant species, almost world-wide in its geographic distribution, although usually at higher altitudes and latitudes. It has been reported previously from Ellesmere Island by Mitten (1878) and others, but not from the northernmost part.

### 53. *Pohlia nutans* (Hedw.) Lindb.

On rocky, steeply sloping, weakly or hardly calcareous scree slopes on E. slope of Mt. Pullen and vicinity (35313b). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35782a).

A nearly cosmopolitan species at higher altitudes and latitudes of both Northern and Southern hemispheres. Although previously reported from Ellesmere Island by Bryhn (1907), these collections seem to represent a northward extension of range.

## MNIACEAE

### 54. *Cinclidium arcticum* (BSG.) C. Müll.

In clay-shale barrens with shallow pools, area SW. of station, Alert (\*35086). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (\*35167). On clayey and calcareous snow-fed solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, just E. of Colan Bay (35207a, 35213a). In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35532). On moist, gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822).

A circumpolar, truly arctic species that has been reported already from Ellesmere Island, though from localities much farther south than the present ones. From my field experience in arctic Alaska and on the arctic Canadian mainland, I believe that this species is much more common than would appear from the frequency with which it is reported; because of its general lack of sporophytes, collectors tend to overlook it.



**55. *Cinclidium latifolium* Lindb.**

In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35861).

Although this species, originally described from arctic Siberia, was first reported from arctic America relatively recently (Hesselbo, 1937), and not previously known from Ellesmere Island, its presence in Schuster's collections is not surprising, since within the past decade it has been found to be widely distributed in the Western Hemisphere (Steere, 1953). I have collected it in abundance at Churchill (in 1956) and at Coppermine (in 1948) in northern Canada, and throughout arctic Alaska. In the Canadian Arctic Archipelago, it has been reported previously from Prince Patrick Island (Steere, 1955).

**56. *Cyrtomnium hymenophyllum* (BSG.) Holmen, The Bryologist 60:138. 1957. (*Mnium hymenophyllum* BSG.; *Cinclidium hymenophyllum* Lindb.).**

In dry eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35350f). In clay-shale barrens with shallow pools, SW. of station, Alert (35078). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167). On rocky, steeply sloping, weakly or hardly calcareous scree slopes on E. slope of Mt. Pullen and vicinity (\*35325a). On calcareous shallow slope draining into Ravine Bay, stony outwash plain, half a mile N. of Mt. Pullen (\*35382b). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35827a).

A circumpolar species, widely distributed in arctic and subarctic regions and often locally common and abundant. It has been reported from northernmost Ellesmere Island previously by Bryhn (1908). Holmen's exciting (1957) discovery in Greenland of the sporophytes of this species, which had been known for over a hundred years only in sterile condition, illustrates clearly the importance of supporting the field work of bryologists in out-of-the-way places, so that they do not have to depend on inadequate collections of specialists in other groups of organisms for their concepts of species, of geographical distribution, etc. The experienced eye and conscientious field work of Holmen in Greenland during several seasons has finally solved the old problem of the systematic position of this handsome moss, for which he is to be warmly congratulated.

**57. *Mnium blyttii* BSG.**

In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35125).

A widely distributed but apparently uncommon circumpolar moss of arctic and subarctic regions, which has been reported previously from the south coast of Ellesmere Island, and from a high latitude of 82°54' N. in NE. Greenland (Hesselbo, 1923). In my own experience, this species is widely distributed in arctic Alaska and may occasionally occur in some abundance.



58. *Mnium hymenophylloides* Hübner.

On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144).

An arctic-alpine circumpolar species with a widespread distribution in the Canadian Arctic Archipelago; reported previously from the Hayes Sound region of Ellesmere Island by Bryhn (1907). This appears to be the northernmost station for the species in Canada.

In view of Holmen's creation of the new genus *Cyrtomnium* for *Mnium hymenophyllum* BSG., one cannot help but wonder if the present species may not eventually turn out to belong there, too (Holmen, 1957).

59. *Mnium serratum* Brid. [*M. marginatum* (Dicks.) Beauv.]

In clay-shale barrens with shallow pools, area SW. of station, Alert (35077a).

A circumboreal species of alpine and subarctic habitats, this apparently also occurs elsewhere in arctic regions, as it is reported from Spitsbergen. The present collection confirms beyond doubt the existence of *M. serratum* in the Canadian Arctic Archipelago, as the previous report (Dickie, 1869) was published with serious reservations (Steere, 1948).

60. *Mnium orthorhynchum* Brid.

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (\*35060b). In local, moist, relatively rich moss-tundra on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35129b). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On low scarp, edge of persistent snowfield, calcareous, permafrost 2 to 4 inches below surface, one-quarter mile N. of Mt. Pullen (\*35361, 35371a). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411, 35414, 35418, 35420). On rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35529, 35534, 35536). In Camp Ravine, Hilgard Bay (35927a, 35930).

A not uncommon and often abundant species throughout boreal, subarctic, and arctic circumpolar regions. Although it has not been previously reported from northernmost Ellesmere Island, it has been collected at 82°53' N. lat. at Lemming Fjord in northeast Greenland (Hesselbo, 1923).

61. *Mnium rugicum* Laur. emend. Tuomik.

On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35404).

According to Tuomikoski (1936), much, if not all, of the material reported from arctic America as *Mnium affine* Bland., or as one of its several varieties, really belongs in the critical species, *M. rugicum* Laur., as emended by Tuomikoski. This is apparently the northernmost station so far reported from Ellesmere Island, although the species is apparently not rare farther south in the Canadian Arctic (Steere, 1948).



## AULACOMNIACEAE

**62. *Aulacomnium acuminatum* (Lindb. & Arn.) Paris**

On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, *ca.* 2,000 to 3,000 feet alt. (35568).

Originally described from Siberia (Lindberg and Arnell, 1890), but reported from Ellesmere Island more than half a century ago (Bryhn, 1907). This is a typically arctic species with a much wider distribution than realized a decade ago (Steere, 1953) but is apparently new for the north coast of Ellesmere Island.

**63. *Aulacomnium palustre* (Hedw.) Schwaegr.**

On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (\*35313b). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (\*35402, 35404).

This is a very abundant and widely distributed boreal species that extends northward into truly arctic regions but at higher latitudes and altitudes is generally sterile and reduced in size.

**63a. *Aulacomnium palustre* var. *imbricatum* BSG.**

On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, *ca.* 2,000 to 3,000 feet alt. (\*35594).

Like the species, this variety is essentially boreal in its distribution and rarely extends its geographical range to truly arctic habitats. This seems to be the first report of the variety from the Canadian Arctic Archipelago.

**64. *Aulacomnium turgidum* (Wahlenb.) Schwaegr.**

In local, moist, relatively rich moss-tundra on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35118b, \*35119, 35125). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (\*35313b, 35315, 35327, 35350). On low scarp, edge of persistent snow-field, calcareous, permafrost 2 to 4 inches below surface, one-quarter mile N. of Mt. Pullen (35365a). On dry scree slopes, not or hardly calcareous, near summit, The Dean (35392b, 35399a). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35420, 35421, \*35425). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, *ca.* 2,000 to 3,000 feet alt. (\*35568, 35593c, 35596, \*35605). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35794).

One of the commonest of all circumpolar mosses, typical of all areas in subarctic and arctic regions, yet never truly weedy.

## CATOSCOPIACEAE

**65. *Catoscopium nigrum* (Hedw.) Brid.**

In clay-shale barrens with shallow pools, area SW. of station, Alert (35086). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144). On clayey and calcareous solifluction slope,



2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35207a, 35211, 35213a). On rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35531). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (\*35873). In Camp Ravine, Hilgard Bay (35926).

A species that is especially common in boreal and subarctic calcareous fens, it extends less abundantly into truly arctic regions, where it is found as an occasional scattered plant, rather than as a dominant species. It has been reported previously from Ellesmere Island, but not from the northernmost part (Bryhn, 1907).

## BARTRAMIACEAE

### 66. *Bartramia ithyphylla* Brid.

In clay-shale barrens with shallow pools, area SW. of station, Alert (35081). In local, moist, relatively rich moss-tundra, calcareous clay-shale sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35116a). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35315, 35350). On dry scree slopes, not or hardly calcareous, near summit, The Dean (35399a). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean, near base (35401d; \*35405a, c. fr.; 35411; 35425). On dry, noncalcareous, scree slope, 4 to 5 miles W. of Peak 1 (35551a). On scree slope 9 to 10 miles W. of Peak 2, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35594).

Widely distributed in arctic and subarctic regions; probably much more common than reported, on the basis of its abundance in arctic Alaska. Previously reported from Ellesmere Island (Bryhn, 1907) but not from the north coast.

### 67. *Philonotis fontana* (Hedw.) Brid.

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35050f). In clay-shale barrens with shallow pools, area SW. of station, Alert (35079a, \*35089(1), 35091). In local, moist, relatively rich moss-tundra, calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35116a, 35122b, 35123a, 35129b). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35149). In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35161, 35162, 35167, 35167b). On clayey and calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35207a). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35311, 35313b, 35314, 35315, 35325a, 35330, 35348). On low scarp, edge of persistent snowfield, calcareous, permafrost 2 to 4 inches below surface, one-quarter mile N. of Mt. Pullen (35362a, 35371a). On stony outwash plain, calcareous shallow slope, draining into Ravine Bay, half a mile N. of Mt. Pullen (35382b). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411, \*35418, 35419). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on



S. side of Hilgard Bay (35476). In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (35527, 35529, 35532, 35542, 35548c). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35561, 35586b, 35601, 35602). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35734b, 35766, 35782f, \*35796). On moist gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822a, b; 35825). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35893). In Camp Ravine, Hilgard Bay (\*35926, 35928, 35931c, 35932).

An almost cosmopolitan species in all temperate, boreal, and subarctic regions, and extremely variable; however, it is not a typically arctic species although previously reported from northernmost Ellesmere Island (Mitten, 1878).

#### 68. *Philonotis tomentella* Mol.

On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144). On moist, gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822).

By far the most common and widely distributed species of *Philonotis* in the American Arctic, previously reported from northernmost Ellesmere Island, this seems surprisingly infrequent in Schuster's collections, perhaps because of the essential dryness of the habitats.

### TIMMIACEAE

#### 69. *Timmia austriaca* Hedw.

In dry, eroded saxifrage barrens, on windblown areas where snow-cover is slight or nonexistent, within one mile of station, Alert (35050a, 35050f, 35060b, 35065, 35069a). In clay-shale barrens with shallow pools, area SW. of station, Alert (35077, \*35079). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35116a, 35118b, 35119, 35125, 35129b). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35145). In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (\*35159a, 35167). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On rocky, steeply sloping, weakly or hardly calcareous scree slopes on E. slope of Mt. Pullen and vicinity (35313b, 35314, \*35315, 35325a, 35327, \*35330, 35341a, 35350). On low scarp, edge of persistent snowfield, permafrost 2 to 4 inches below surface, calcareous, one-quarter mile N. of Mt. Pullen (35361, \*35362a, \*35365a, \*35368a, \*35368c, 35371, 35371a). On calcareous, shallow slope draining into Ravine Bay, stony outwash plain, half a mile N. of Mt. Pullen (35382b). On dry scree slopes, not or hardly calcareous, near summit of The Dean (35392b). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean, near base (35411, 35414, 35418, 35420, 35425). On rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35528, 35543a, 35548c). On scree slope 4 to 5 miles W. of Peak 1, on dry, noncalcareous scree (\*35555b). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35562, 35569,



35571a, 35582, 35586b, 35593c, 35596, \*35602, 35614b). On slope, 3 to 4 miles W. of Peak 1 (35706a). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35731b, 35733b, 35782a, 35782b, 35794, 35796). On moist, gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35818). In Camp Ravine, Hilgard Bay (35926, 35927a, 35928, 35931a, 35932).

Already reported from northernmost Ellesmere Island by Mitten (1878); this is a common and widespread species in nearly all boreal, sub-arctic, and arctic regions, and yet it does not seem to be a weed.

#### 70. *Timmia norvegica* Zett.

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35051a). In clay-shale barrens with shallow pools, area SW. of station, Alert (35080, \*35080a, 35081, 35097, 35098). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35123a). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35148a). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167b, 35179a). In clay-shale, damp moss-tundra, calcareous, Cape Belknap (\*35290). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35311, 35348). On calcareous shallow slope draining into Ravine Bay, stony outwash plain, half a mile N. of Mt. Pullen (35382b). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean (35419, 35420). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (35476). On rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (35532, \*35534, 35536, 35540, 35542). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35562, 35601). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35766, \*35782, 35788). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822a, b; 35825). On clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35877).

Although previously reported from northern Ellesmere Island (Bryhn, 1908), this species has been surprisingly infrequently reported from the Canadian Arctic Archipelago (Steere, 1948). However, from personal experience in the Great Bear Lake and Coppermine areas of the Northwest Territories of Canada and in arctic Alaska, I can testify that in the field this species is neither rare nor infrequent.

### ORTHOTRICHACEAE

#### 71. *Amphidium lapponicum* (Hedw.) Schimp.

In local, moist, relatively rich moss-tundra on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35125). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411).



Although not a common species, and rarely abundant, this one is widespread throughout the colder parts of the Northern Hemisphere and reaches 82°53' N. lat. in northernmost Greenland, at Lemming Fjord (Hesselbo, 1923).

## 72. *Orthotrichum speciosum* Nees

In clay-shale barrens with shallow pools, area SW. of station, Alert (\*35073, *c.fr.*). In local, moist, relatively rich moss-tundra, in calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35119, \*35128, 35130). On clay-shale, damp moss-tundra, calcareous, Cape Belknap (\*35285). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35309). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean, near base (\*35414, \*35422). On rocky, clayey moss-tundra on more or less stable slopes, valley between Peak 1 and Peak 2 (35538). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, *ca.* 2,000 to 3,000 feet alt. (35569, *c.fr.*; 35581, 35583, \*35587, 35588, 35591, 35593, 35595*c.*, \*35606, \*35611, \*35611*b.*). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (\*35761, 35761*b.*, 35764, \*35764*a.*). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (\*35816, \*35818).

This name has been selected because of the absolutely smooth yellow, exserted capsules and the acuminate leaves; the species was reported from northern Ellesmere Island by Mitten (1878) and has a wide distribution in the Northern Hemisphere, although not ordinarily a common or abundant arctic species.

## THELIACEAE

## 73. *Myurella julacea* (Schwaegr.) BSG.

In clay-shale barrens with shallow pools, area SW. of station, Alert (35097). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt (35123*a.*, 35125). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167, 35167*b.*, 35179*a.*). On clayey and calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35213*a.*). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35311, 35325*a.*, 35348). On low scarp, edge of persistent snowfield, calcareous, permafrost 2 to 4 inches below surface, a quarter mile N. of Mt. Pullen (35361). On calcareous, shallow slope, draining into Ravine Bay, stony outwash plain, half a mile N. of Mt. Pullen (35382*b.*). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (\*35411, 35418, 35419, 35420, 35425, 35429). On more or less stable slopes, rocky, clayey moss-tundra, valley between Peak 1 and Peak 2 (\*35539, 35543*a.*, 35548*c.*). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range (35562,



35567, 35571a, 35586b, 35601, 35602, 35608a). On slope, 3 to 4 miles W. of Peak 1 (\*35706a). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35761a, 35788). On moist, calcareous clay, Upper Dumbbell Lake (35893). In Camp Ravine, Hilgard Bay (35927a, 35928, 35930).

An extremely common and widespread species in calcareous habitats in the cooler parts of the Northern Hemisphere, but rarely abundant, reaching its northernmost extension at 83°02' N. lat. in N. Greenland (Hesselbo, 1923). It has been reported previously from Grant Land by Bryhn (1908).

**74. *Myurella tenerrima* (Brid.) Lindb.**

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35060b, 35067). In clay-shale barrens with shallow pools, area SW. of station, Alert (35077a). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35116a, 35122b). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35348). On low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35362a, 35368c, 35371a). In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (35540). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35595c, 35601). On slope 3 to 4 miles W. of Peak 1 (35706a). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (\*35734b, 35766, 35796). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822).

A common and widespread arctic and subarctic species long ago reported from northern Ellesmere Island (Mitten, 1878; Bryhn, 1908).

AMBLYSTEGIACEAE

**75. *Calliergon giganteum* (Schimp.) Kindb.**

In clay-shale barrens with shallow pools, area SW. of station, Alert (35092, 35095). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35870).

A widespread and not uncommon boreal species that extends surprisingly far northward into most arctic regions, it has been previously reported from northern Ellesmere Island (Bryhn, 1908).

**76. *Calliergon stramineum* (Brid.) Kindb.**

In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35875).

This species is not uncommon in boreal, subarctic, and arctic regions of the Northern Hemisphere in acid to slightly calcareous habitats but is rarely abundant in pure stands. Bryhn (1908) has reported it from northern Ellesmere Island.



**77. *Calliergon turgescens* (Th. Jens.) Kindb.**

In clay-shale barrens with shallow pools, SW. of station, Alert (35088, 35089, 35091, \*35092, 35095). In clayey, calcareous, low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35861, 35863, 35866, 35867, 35870, 35873, \*35874, 35877).

A common and abundant species in slightly to strongly calcareous ponds and fens through arctic and subarctic regions, either in pure stands in ponds or in mixture with many other species in less wet places; not previously reported from northernmost Ellesmere Island (Bryhn, 1907).

**78. *Cratoneuron arcticum* Steere sp. nov.<sup>1</sup>**

Plants delicate, densely matted together or occurring as single stems creeping among other mosses, golden red where exposed and bright green where shaded. Stems reaching 2 to 3 cm in length, much and irregularly branched, not pinnate, densely foliate, paraphyllia absent. Leaves rather stiffly erect-spreading when moist, imbricate but otherwise little altered when dry, somewhat to clearly falcate toward the substratum especially at the ends of stems and branches; distant and much reduced on elongated, stolon-like lower parts, lanceolate, somewhat asymmetric, long acuminate to filiform acuminate, 0.8 to 1.2 mm long, 0.2 to 0.3 mm wide, concave at the base, not at all striate or plicate; costa strong + 50  $\mu$  wide at base, disappearing in the apex to conspicuously excurrent in apical leaves; margins plane throughout, regularly slightly to strongly serrulate from base to apex by the minutely projecting thickened upper corners of the marginal cells. Leaf cells irregularly rhomboidal to fusiform, their walls much thickened, 6 to 12  $\mu$  wide, mostly about 9  $\mu$ ; 22 to 39  $\mu$  long, mostly about 30  $\mu$ ; marginal cells and those next the costa narrower, apical cells longer, especially in the acumination, basal and alar cells not decurrent, forming a highly and conspicuously differentiated excavate group extending from costa to margin. Below the normal leaf cells, several rows of smaller, rounded somewhat opaque cells, quadrate at the margins, are set off, and at the very base are 1 to 2 rows of much larger (to 30  $\mu$  in diameter), yellow, extremely thick-walled cells which often remain attached to the stem when the leaf is removed. Sexual structures not observed; sporophyte lacking.

**GEOGRAPHICAL DISTRIBUTION:** CANADA: Ellesmere Island. In clay-shale barrens with shallow pools, area SW. of station, Alert, June 13, 1955, Schuster \*35089 (in association with *Campylium stellatum*, *Holmgrenia chrysea*, *Drepanocladus badius*, *Calliergon turgescens*); in clay-shale, damp moss-tundra, calcareous, Cape Belknap, July 17, 1955, Schuster \*35285 (Type; in herb. National Museum of Canada) (in association with *Orthotrichum speciosum*, *Grimmia gracilis*, c.fr., *Tortula ruralis*, *Barbula icmadophila*); on old musk-ox excrement, in moist calcareous clay-shale slope at S. end of Parr Inlet, S. of Alert, August 26, 1955, Schuster 35937a (in association with *Voitia hyperborea*, *Bryum arcticum*, *Didymodon rufus*, *Barbula icmadophila*, *Fissidens arcticus*, *Tetraplodon paradoxus*, *Pohlia cruda*). ALASKA: On soil in crevice between boulders, mountainside south of

<sup>1</sup>*Cratoneuron arcticum* Steere sp. nov. Planta tenuis, caespitosa, chryseo-rufescens. Caulis repens, vage ramosus et ramulosus, dense foliosus, gracilis, rigidus, 2 to 3 cm longus. Folia conferta, erecto-patula, sicca laud contorta, ca. 2 mm longa, recta vel apice secunda, lanceolata, sensim tenuiter acuminata, toto margine subdenticulata vel denticulata, plana; costa valida in apicem continua; cellulae rhomboidei-fusiformes, ca. 9  $\mu$  latae, ca. 30  $\mu$  longae, ad angulos valde excavatos rotundato quadratis. Caetera ignota.





*CRATONEURON ARCTICUM* Steere sp. nov.

- Fig. 1. General habit of stem and branches in moist condition,  $\times 7.5$ .  
 Fig. 2. Habit of branch, to show insertion and arrangement of leaves when moist,  $\times 25$ .  
 Fig. 3-5. Branch leaves,  $\times 100$ .  
 Fig. 6, 7, 10. Areolation of leaf cells at and near base,  $\times 700$ .  
 Fig. 8. Areolation of leaf cells at a point about halfway between base and apex,  $\times 700$ .  
 Fig. 9. Areolation of leaf cells in upper part of leaf,  $\times 700$ .  
 Fig. 11, 12. Areolation of leaf cells within the apex,  $\times 700$ .

(All drawings were made by Miss Jennifer Wootton.)



Peters Lake, area just southwest of Mt. Chamberlin, Franklin Mountains, Brooks Range, approx. 69°22' N. lat., 145°03' W. long., about 3,000 feet alt., July 27, 1952, *Steere 18835*. Type material deposited in the following herbaria: National Museum of Canada, New York Botanical Garden, Stanford University, University of Massachusetts.

The generic position of this moss is questionable until sporophytes are discovered. At first sight it strongly suggests the genus *Lescuraea*, where I placed it after preliminary study. However, Dr. Elva Lawton, who has recently (1957) revised the genus, tells me that it does not belong there, in part because of the total lack of papillae. The plane margins of the leaves and the very different basal cells combine to give further evidence against an affiliation with *Lescuraea*. The percurrent to excurrent costa, the rhomboidal-fusiform cells, the serrulate margins, and the highly differentiated basal cells provide a constellation of characteristics that does not fit very well any genus known to me. Because of the strong costa and serrulate margins, I have placed this material in the genus *Cratoneuron*, in spite of the nonaquatic habitat, the nondecurrent basal cells, the lack of paraphyllia, and the nonplicate leaves.

#### 79. *Cratoneuron filicinum* (Hedw.) Roth

In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35875). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35893).

A widespread species in the colder parts of both the Northern and Southern hemispheres, but surprisingly little known in arctic America, even though previously reported from northernmost Ellesmere Island (Bryhn, 1908).

#### 80. *Campylium stellatum* (Hedw.) Lange & C. Jens.

In clay-shale barrens with shallow pools, SW. of station, Alert (35086, 35089, 35089 [1,2], 35091, 35093, \*35099). On clayey, calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35213a). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35311). On more or less stable slopes, rocky, clayey moss-tundra, valley between Peak 1 and Peak 2 (35532). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35562). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35861, \*35863, 35866, 35870, 35875, 35877). In Camp Ravine, Hilgard Bay (\*35931c, \*35932).

This is the commonest and most widely distributed species of *Campylium* in arctic regions, and one of the most prevalent mosses in moist, calcareous arctic fens and bogs, all the way from pure stands to single stems among many other species.

#### 81. *Drepanocladus badius* (Hartm.) Roth

In clay-shale barrens with shallow pools, area SW. of station, Alert; in clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35861).



This is the first report from northern Ellesmere Island of a species that is widespread but uncommon in arctic America. It is known in the Canadian Arctic Archipelago from relatively few collections (Steere, 1948), and this is the first report from northern Ellesmere Island, even though Troelsen's collections from Slidre Fjord (Holmen, 1953) represented until now the farthest north station in the Canadian Arctic.

**82. *Drepanocladus brevifolius* (Lindb.) Warnst.**

In clay-shale barrens with shallow pools, area SW. of station, Alert (\*35087, 35089 [1,2] 35091, \*35092, 35097). On moist, gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35822). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35861, 35866, 35868, 35870, \*35871, 35873, \*35875, 35876). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet (35887).

This species, originally described from arctic Asia, is widespread and much more common in arctic North America than realized a decade ago, even though reported from northernmost Ellesmere Island by Bryhn (1908). My own field studies in arctic Alaska during three field seasons (1951-53) and my study of several extensive collections made by friends and colleagues make me realize that this is a perfectly good species in its own right and should not have to stand in the shadow of *Drepanocladus lycopodioides*, which is one of the best characterized species of the genus when well developed. I realize now that much of which I had considered to be aberrant forms of *D. lycopodioides*—and so reported—from Cornwallis Island (Steere, 1951) and from Prince Patrick Island (Steere, 1955) are better treated as a separate and well-characterized species, *D. brevifolius*, which unfortunately has been described under a plethora of names. This is a truly arctic species, belonging to a unique floristic element (Steere, 1953) of mosses restricted to very high latitudes.

**83. *Drepanocladus fluitans* (Hedw.) Warnst.**

On more or less loose scree, SW. slopes of Mt. Pullen, and near summit (35770b).

An extremely variable and widely distributed moss in both Northern and Southern hemispheres that has already been reported from northern Ellesmere Island (Bryhn, 1908). As previously indicated (Steere, 1948), this is not a truly arctic species and so is relatively rare at high latitudes, with their surprisingly dry climates.

**84. *Drepanocladus lycopodioides* (Brid.) Warnst.**

In clay-shale barrens, at shallow pools, one mile SW. of station, Alert (\*35088, \*35099). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35863, 35869, 35872).

This is a rare arctic moss of highly calcareous habitats that has been too often confused with many others (See remarks under *D. brevifolius*), yet which in its full and typical development is quite unmistakable.

**85. *Drepanocladus revolvens* (C. Müll.) Warnst.**

In clay-shale barrens with shallow pools, area SW. of station, Alert (35086). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144). On clayey, calcareous solifluction slope, 2.5



miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35207a, 35213a). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35327, \*35348). On rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (35532). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35766). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35861, 35867, 35871, 35875, 35876). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35886, 35893).

This is an abundant species of calcareous bogs and fens in the colder parts of the Northern Hemisphere that reaches 82°02' N. lat. at Cape Benet, on the north Coast of Greenland (Hesselbo, 1923). It has been previously reported from northernmost Ellesmere Island (Bryhn, 1908).

#### 88. *Drepanocladus uncinatus* (Hedw.) Warnst.

In local, moist, relatively rich moss-tundra, calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt (35116a, 35125). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35162). On calcareous clay-shale slope, in Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35314, 35315, 35317a, 35318b, 35327, 35330, 35350). On low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35361, 35362a, 35371a). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35402, 35404, 35418, 35419, 35425). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (35555b). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet (35582, 35594). On slope, 3 to 4 miles W. of Peak 1 (\*35702). On more or less loose scree, SW. slopes of Mt. Pullen (35731b).

An almost cosmopolitan species, in both Northern and Southern hemispheres, at high altitudes and high latitudes, so well known in Ellesmere Island that no further comment is necessary.

#### 89. *Hygrohypnum alpestre* (Hedw.) Loeske

In rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (\*35476).

Although originally described from northern Europe and reported from Alaska, the Yukon Territory, and Greenland, this seems to be the first report of the species from the Canadian Arctic Archipelago at its northernmost extension.

#### 90. *Hygrohypnum montanum* (Wils.) Broth.

On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35887).

Originally described from the White Mountains of New England and known from many localities in Newfoundland, Canada, Japan, and Europe, this seems to be the first report from the northernmost part of the Canadian Arctic Archipelago.



**91. *Hygrohypnum polare* (Lindb.) Broth.**

In valley between Peak 1 and Peak 2, in rocky, clayey moss-tundra, on more or less stable slopes (\*35527).

A truly arctic species known from arctic and subarctic Europe, Asia, and North America; previously reported from the Canadian Arctic Archipelago only from Ellesmere Island, from farther south (Bryhn, 1907; Holmen, 1953) than the present locality. Polunin has sent me well-developed material of this species from Ice Island T-3, which is thought to have broken away from the ice-shelf at the northwest coast of Ellesmere Island.

BRACHYTHECIACEAE

**90. *Cirriphyllum cirrosum* (Schwaegr.) Grout**

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35060b). Clay-shale barrens with shallow pools, SW. of station, Alert (35091). In local, moist, relatively rich moss-tundra, calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35123). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144, 35147). In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (\*35161). On clay-shale, damp moss-tundra, calcareous, Cape Belknap (35287). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35311). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (\*35419). In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35527). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35601). On clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35867). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35893). In Camp Ravine, Hilgard Bay (35926).

A very widely distributed species of all arctic regions; on the basis of my own field experience in arctic Alaska, much more common than usually recognized, since it usually occurs as scattered stems in other mosses and rather rarely as large and pure stands. It has been reported previously from northern Ellesmere Island by Mitten (1878).

**91. *Tomenthypnum nitens* (Hedw.) Loeske**

In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (\*35119, \*35125, 35129b). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (\*35144, \*35147). On low scarp, edge of persistent snowfield, one quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35361, 35371, 35371a). In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35542, 35543a). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35571a, 35601). In Camp Ravine, Hilgard Bay (35926, 35931c, 35932).



A common, extremely widespread, and often abundant moss in all boreal, subarctic, and arctic regions; previously reported from northern Ellesmere Island (Mitten, 1878), it reaches its northernmost station at Cape Benet, 83°02' N. lat., on the north coast of Greenland (Hesselbo, 1923).

## ENTODONTACEAE

### 92. *Holmgrenia chrysea* (Schwaegr.) Lindb.

In dry, eroded saxifrage barrens on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (\*35068, 35069). In clay-shale barrens with shallow pools, area SW. of station, Alert (\*35078, 35079a, 35080, \*35080a, 35081a, \*35089, \*35090, \*35091, 35094, \*35097, 35099). In local, moist, relatively rich moss-tundra on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35122b, 35123a, 35125). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144, 35145, 35149). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous (35161, 35167). On clayey and calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope, just E. of Colan Bay (35207a, 35211, \*35213a). In clay-shale, damp moss-tundra, calcareous, Cape Belknap (35290). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35311, 35314, 35315, 35325a, 35327, 35348). On low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35362a). On stony outwash plain half a mile N. of Mt. Pullen, on calcareous shallow slope, draining into Ravine Bay (\*35382b). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35418). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (35476). On rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (\*35530, 35535, 35536, 35542, 35543a, 35543, 35545, 35548c). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (35551a). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (\*35601). On more or less loose scree, SW. slopes of Mt. Pullen, and near summit (35731, 35766, 35782). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35821, 35822, 35825). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35867, 35868, 35873, 35877). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35877, 35882, 35886, 35893). In camp Ravine, Hilgard Bay (\*35926, 35928). On moist calcareous low flats, Parr Inlet (35937).

A circumboreal arctic-alpine species in every arctic region; often common; reported from northern Ellesmere Island by Mitten (1878) and Bryhn (1908).

### 93. *Holmgrenia stricta* (Lor.) Lor.

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35051a). In clay-shale barrens with shallow pools, area SW. of station, Alert (\*35081a, \*35093, 35099). On calcareous clay-shale slope, Camp Ravine, S. end of



Hilgard Bay, 12 to 15 miles SW. of Alert (\*35229). On low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35362a). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (354862). On slope 3 to 4 miles W. of Peak 1 (35706a). On moist, gravelly, and clayey slope at edge of Arctic Ocean (35827a). On clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35868, 35869). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet alt. (35882). In Camp Ravine, Hilgard Bay (\*35927a, 35930, 35932).

Although neither so common nor so abundant as the preceding species, the present one is nearly as widespread geographically, and both Mitten (1878) and Bryhn (1908) have reported it from northern Ellesmere Island.

#### HYPNACEAE

##### 94. *Amblystegiella sprucei* (Bruch) Loeske

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent, within one mile of station, Alert (35060b). In clay-shale barrens with shallow pools, SW. of station, Alert (35079a). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35167). On calcareous clay-shale slope, Camp Ravine at S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35229, 35249). On rotting rock outcrop, not strongly calcareous, in shade, mouth of ravine on S. side of Hilgard Bay (35486a). In rocky, clayey moss-tundra on more or less stable slopes, valley between Peak 1 and Peak 2 (35542, 35543a). In Camp Ravine, Hilgard Bay (35931, 35932).

A circumboreal arctic and subarctic (arctic-alpine) species very widespread in arctic regions; previously reported from northern Ellesmere Island by Bryhn (1908).

##### 95. *Hypnum bambergeri* Schimp.

In clay-shale barrens with shallow pools, area SW. of station, Alert (\*35075, 35088, 35094, \*35098). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35110). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (\*35148a). On clayey and calcareous solifluction slope, 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35207a, \*35211). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (\*35571a, 35601). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35774). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35821, 35822). In clayey, calcareous low areas, ponds between Parr Inlet and Upper Dumbbell Lake (35871, 35873). On moist, calcareous clay, Upper Dumbbell Lake, ca. 125 feet (35873, 35882, 35883). On moist, calcareous, low flats, Parr Inlet (35937).

I was not familiar with this species in the field during my survey of the mosses of the Canadian Eastern Arctic (Steere, 1948) and undoubtedly overlooked many occasional single stems in admixture with other species.



However, during field work in arctic mainland Canada and in arctic Alaska, I have come to know this species very well and realize that it probably occurs in almost every slightly to strongly calcareous bog, fen, and marsh of arctic North America. Holmen (1953) first reported this species from Ellesmere Island, but Schuster's collection represents the northernmost station in the Canadian Arctic Archipelago, although the species has been reported from the north coast of Greenland at 82°28' N. lat. (Hesselbo, 1923).

#### 96. *Hypnum callichroum* Brid.

In local, moist, relatively rich moss-tundra, in calcareous-clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35119). On snow-fed solifluction slope, rich moss-tundra, head of Parr Inlet, Dumbbell Bay (35144). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (\*35315). On low scarp, edge of persistent snowfield, a quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35365a). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35392b, 35399a).

A widespread species in many arctic regions; though it appears to be relatively common in northernmost Alaska, it has not been reported previously from Ellesmere Island.

#### 97. *Hypnum cupressiforme* Hedw.

In clay-shale barrens with shallow pools, area SW. of station, Alert (35074, \*35075). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35128). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slope of The Dean (35159a). On calcareous clay-shale slope, Camp Ravine, S. end of Hilgard Bay, 12 to 15 miles SW. of Alert (35249). On clay-shale, damp moss-tundra, calcareous, Cape Belknap (35287). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35350). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35421, 35422). On firm, moss-covered, more or less calcareous, stabilized scree slopes, cliff face at S. end of Hilgard Bay (35512). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (35551a). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35569, 35588). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35764). On more or less noncalcareous, rotting schist and slate ledges, in deep ravine, S. side of Hilgard Bay (35911).

An extraordinarily common, abundant, and variable species in Europe and Asia, but rather stable and somewhat rarer in North America, although much more common than would appear from reports of its occurrence (Bryhn, 1907; Steere, 1948). In the arctic mainland of Canada at Great Bear Lake and at Coppermine and throughout arctic Alaska, this species may be common and often abundant.



**98. *Hypnum revolutum* (Mitt.) Lindb.**

In dry, eroded saxifrage barrens, on wind-blown areas where snow cover is slight or nonexistent; within one mile of station, Alert (\*35050, 35067). In clay-shale barrens with shallow pools, area SW. of station, Alert (35072, \*35076, 35077a). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35118b, 35125). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35179a). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (\*35309, 35327). On low scarp, edge of persistent snowfield, one-quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35368c, 35371a). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35418). In rocky, clayey moss-tundra, on more or less stable slopes, valley between Peak 1 and Peak 2 (35545). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35569, 35581, \*35582, 35587, \*35589, 35593, 35595c, 35606, 35611, 35611b). On slope 3 to 4 miles W. of Peak 1 (35703, 35704). On more or less loose scree, SW. slopes of Mt. Pullen and near Summit (35733b, 35734b, 35761a, 35764, 35764b, 35774). On moist, gravelly, and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35818).

This is a common arctic-alpine species that reaches all arctic regions. It has been reported from many collections in northern Ellesmere Island (Mitten, 1878; Bryhn, 1907, 1908). It reaches 83°06' N. lat. in northernmost Greenland at Low Point.

**99. *Hypnum vaucheri* Lesq.**

In clay-shale barrens with shallow pools, area SW. of station, Alert (35072). In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35125, 35130). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35591, 35592, 35611). On slope 3 to 4 miles W. of Peak 1 (35704).

An arctic-alpine moss that, although not common, is very widespread in boreal and arctic regions, especially in exposed areas; previously reported from Grant Land by Bryhn (1908).

**100. *Isopterygium pulchellum* (Hedw.) Jaeg.**

In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35123a, 35129b). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (35159a). On clayey and calcareous solifluction slope 2.5 miles W. of Cape Belknap, S. of Williams Island, on a snow-fed slope just E. of Colan Bay (35211). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, E. slope of Mt. Pullen and vicinity (35327, 35348). On low scarp, edge of persistent snowfield, a quarter-mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35362a, 35371). On dry scree slopes, not or hardly calcareous,



near summit of The Dean (35399a). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35411, 35418, 35425). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35595c, 35601, 35614b). On slope 3 to 4 miles W. of Peak 1 (35704). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35761, 35761a). In Camp Ravine, Hilgard Bay (35932).

A circumboreal species, not uncommon in higher altitudes and higher latitudes of the Northern Hemisphere, but rarely really abundant; previously reported from Grant Land by Bryhn (1908); reaching 83°06' N. lat. in northernmost Greenland at Low Point.

#### HYLOCOMIACEAE

##### 101. *Hylocomium splendens* (Hedw.) BSG.

In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope, exposed within ten days after start of snow-melt, N. slope of Mt. Pullen (35119, 35123a, 35125). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35311, \*35314, 35315, 35318b, 35330, 35348, 35350). On low scarp, edge of persistent snowfield, a quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35365a, 35371a). On dry scree slopes, not or hardly calcareous, near summit of The Dean (35392b, 35421, 35425). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (\*35555b). On scree slope 9 to 10 miles W. of Peak 2, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35582, 35594, 35596). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35794).

An extremely common moss of moist boreal forests, this species extends northward into all arctic regions but becomes more and more reduced in size and development as the climate becomes more and more rigorous. *Hylocomium alaskanum* (Lesq. & James) Kindb., although freely intergrading with the typical forms of the species, has been used by some authors as a convenient category in which to place the most reduced arctic forms (Steere, 1948).

#### POLYTRICHACEAE

##### 102. *Pogonatum capillare* (Rich.) Brid.

On low scarp, edge of persistent snowfield, a quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35371a). On dry scree slopes, not or hardly calcareous, near summit of The Dean (\*35398a).

A widely distributed species of boreal and arctic regions, surprisingly infrequently reported from arctic America, although abundant in mainland areas of arctic Canada and Alaska where I have collected. This species has been reported from Craig Harbour, Ellesmere Island, on the basis of a Polunin collection (Steere, 1948).

##### 103. *Polytrichum alpinum* Hedw.

In local, moist, relatively rich moss-tundra, on calcareous clay-shale-sandstone slope exposed within ten days after start of snow-melt (35116a,



35118b, 35129b). In rich firn-ice valleys, moss-tundra slopes fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (\*35162, 35167, 35167b). On rocky, steeply sloping, weakly or hardly calcareous scree slopes, on E. slope of Mt. Pullen and vicinity (35311, 35315, 35318b, 35327, 35330, 35348, \*35350). On low scarp, edge of persistent snowfield, a quarter mile N. of Mt. Pullen, calcareous, permafrost 2 to 4 inches below surface (35361, \*35362a, 35365a, 35368c). On calcareous shallow slope draining into Ravine Bay, stony outwash plain half a mile N. of Mt. Pullen (35382b). On dry scree slopes, not or hardly calcareous, near summit of The Dean (\*35399a). On moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35401d, 35402, \*35404, 35411, 35419, 35420). In valley between Peak 1 and Peak 2, on rocky, clayey moss-tundra, on more or less stable slopes (35548c). On dry, noncalcareous scree slope 4 to 5 miles W. of Peak 1 (35555b). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35562, 35569, 35588, 35594, 35595, 35601, 35602). On slope 3 to 4 miles W. of Peak 1 (35706a). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (\*35733b, 35734b, 35770a, \*35782a, \*35782b, \*35782f, 35782g). On moist, gravelly and clayey slope at edge of Arctic Ocean, 1.5 to 2.5 miles W. of Cape Belknap (35825). In Camp Ravine, Hilgard Bay (35927a).

A common and abundant moss throughout boreal and arctic regions that is extremely tolerant of variations in pH, moisture, exposure, and other physical aspects of its environment. This species occurs throughout the colder parts of the Northern Hemisphere and reaches 83°06' N. lat. on the northern coast of Greenland. It also occurs in the Southern Hemisphere and has been reported from northern Ellesmere Island by Mitten (1878).

#### 104. *Polytrichum juniperinum* Hedw.

In rich firn-ice valleys, moss-tundra slopes, fed by permanent firn-ice and hanging snowbanks, calcareous, W. and NW. slopes of The Dean (\*35162). In moist, not or hardly calcareous moss-tundra and rocky clay slopes, W. slope of The Dean near base (35404, 35421, 35425). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35568, 35569). On more or less loose scree, SW. slopes of Mt. Pullen and near summit (35794).

A truly cosmopolitan species in all cooler parts of the world, throughout northern North America, and previously reported from northernmost Ellesmere Island by Williams (1918).

#### 105. *Polytrichum piliferum* Hedw.

On rotting rock outcrop, not strongly calcareous, mouth of ravine on S. side of Hilgard Bay (\*35485). On scree slope 9 to 10 miles W. of Peak 1, toward U.S. Range, ca. 2,000 to 3,000 feet alt. (35614b).

Although widespread in both Northern and Southern hemispheres and extremely tolerant of drought, cold, and exposure, this species is not really common in arctic America, and these collections apparently represent the northernmost stations in arctic Canada.



### III. LICHENES

JOHN W. THOMSON<sup>1</sup>

The lichens collected by Rudolf M. Schuster near Alert total 108 species, including 113 taxa. Of these, 73 have already been reported from Ellesmere Island; 20 species are new to the Canadian Eastern Arctic Archipelago, although they have in the main been previously reported from Greenland; 15 have been previously reported from the Archipelago but not from so far north as Ellesmere Island, and two have not previously been reported from North America, *Pertusaria freyi* var. *monosticha* and *Lecanora polychroma* var. *pallescent*. The largest previous collections on Ellesmere Island were those obtained on the expedition of the *Alert* and the *Discovery*, which were reported by Fries (1879) as containing 102 species. With an overlap of only 72 species with the reports in the previous papers, Schuster's collection represents an exceedingly valuable addition to our knowledge of the lichens of this far northern land. A very large collection was made by Simmons in the "*Fram*" expedition of 1898-1902 and reported upon by Darbishire. Unfortunately, these reports cannot be accepted until all the material is redetermined according to the comments made by Lynge (1947). Gradually as we acquire collections from such northern outposts, more and more high arctic lichens appear to be circumpolar in distribution. It is yet too early a stage in our knowledge to generalize much about distributions of arctic lichens. It is the abundant raw data of collections of the obscure crustose species as well as the more conspicuous larger ones that we so badly need.

#### VERRUCARIACEAE

##### 1. *Verrucaria arctica* Lynge

On moist gravel and clay slope at edge of Arctic Ocean, Cape Belknap (35801d).

New to the Canadian Eastern Arctic. Described from Novaya Zemlya, Lynge (1928), and reported from Greenland (Lynge, 1937, 1940).

##### 2. *Verrucaria* sp.

Too little to determine with certainty, probably in the *V. rupestris* group. Upper Dumbbell Lake (35891a).

##### 3. *Polyblastia bryophila* (Nyl.) Lönnr.

On moss on gravel and clay slope at edge of Arctic Ocean, Cape Belknap (35812b). Sp.  $29 \times 18 \mu$ .

Already reported by Fries for Grant Land.

##### 4. *Polyblastia septentrionalis* Lynge

On W. slope near base of The Dean, calcareous moss-tundra and rocky clay slopes (35427b). Sp.  $21 \times 10 \mu$ .

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Described by Lynge (1928) from Novaya Zemlya and reported by him from W. Greenland (1937).

**5. *Thelidium microsporum* Lynge (Lynge, 1928 *ibid.*)**

On gravel and clay slope at edge of the Arctic Ocean, Cape Belknap (35801c).

New to the Canadian Eastern Arctic.

**6. *Thelidium pyrenophorum* (Ach.) Mudd.**

On W. slope near base of The Dean, on moist, calcareous moss-tundra and rocky clay slopes (35415).

New to the Canadian Eastern Arctic but reported by Lynge from W. Greenland (1937).

COLLEMATACEAE

**7. *Arctomia delicatula* T. Fr.**

On scree slope west of Peak 1 (35610f).

This is reported with some uncertainty as the thalus is sterile. Homio-merous and paraplectenchymatous throughout. There are many reports from Greenland and some from the Bering Sea region. New to the Canadian Eastern Arctic.

**8. *Collema callopismum* Mass. var. *callopismum***

On moist calcareous clay, upper Dumbbell Lake (35889d).

New to the Canadian Eastern Arctic.

**9. *Collema flaccidum* (Ach.) Ach.**

On moist calcareous clay, Upper Dumbbell Lake (35889a).

New to the Canadian Eastern Arctic.

**10. *Collema tenax* (Sw.) Ach.**

On calcareous clayey, low areas near ponds between Parr Inlet and Upper Dumbbell Lake (35864). SW. slopes of Mt. Pullen (35767d).

Already reported for Ellesmere Island (Grant Land) by Fries under the name *Collema pulposum*.

PANNARIACEAE

**11. *Placynthium asprellum* (Ach.) Trev.**

West slope near base of The Dean, on moist, calcareous moss-tundra and rocky clay slope (35415a). West of Alert on dry saxifrage barrens (35842a).

**12. *Psoroma hypnorum* (Vahl.) S.F. Gray**

On low scarp at edge of persistent snowfield N. of Mt. Pullen (35375a, 35373a). West and NW. slopes of The Dean on moss-tundra slopes (35189a). On scree slope W. of Peak 1 (35607a). On loose scree SW. slopes of Mt. Pullen (35747a, 35767c).



Apparently common around Alert as is to be expected from its general distribution in the Arctic, but strangely enough not previously reported from Ellesmere Island except possibly from "Cumberland Sound" by Tuckerman (1879).

#### PELTIGERACEAE

13. *Peltigera aphthosa* (L.) Willd. var. *variolosa* (Mass.) Thoms. f. *complicata* (T. Fr.) Zahlbr.

On calcareous moss-tundra slopes, W. and NW. slopes of The Dean (35189c). On low scarp at edge of persistent snowfield, Mt. Pullen (35364).

14. *Peltigera canina* (L.) Willd. var. *rufescens* (Weis.) Mudd.

On low scarp at edge of persistent snowfield, Mt. Pullen (35364a, f. *incusa* Flot.; 35373a). Camp Ravine, Hilgard Bay (35922). Southwest slopes of Mt. Pullen on loose scree (35767b).

The first of the numbers is f. *incusa* Flot. with very narrow lobes with upturned edges.

15. *Peltigera venosa* (L.) Baumg.

On loose scree, SW. slopes of Mt. Pullen (35747).

This is a northward extension of range of this species which was hitherto reported as far north as Baffin Island.

#### LECIDEACEAE

16. *Lecidea acrocyanea* (T. Fr.) Magn.

On rotting schist and slate ledges S. side of Hilgard Bay with *Caloplaca pyracea* (35918a, 36916a).

This species, which has a beautiful blue upper part of the hymenium, has already been reported from Ellesmere Island by Magnusson (1945). An additional specimen from Churchill (15627c) represents an addition to the list of lichens from that area (Thomson, 1953).

17. *Lecidea assimilata* Nyl.

On mosses, plateau near Hilgard Bay (35940).

Reported from Gøya Harbor by Lynge (1921), this is a northernmost record for this species, which is probably widespread in Arctic range but only accidentally collected in material gathered for more conspicuous species.

18. *Lecidea auriculata* T. Fr.

On rocks, Camp Ravine, Hilgard Bay (35919).

19. *Lecidea confluens* E. Fr.

On stones on moist, gravelly, and clayey slope at edge of the Arctic Ocean, W. of Cape Belknap (35803, 35809); just W. of Alert in dry saxifrage barrens (35851).

The northernmost previously reported station was on Baffin Island (Lynge, 1947; Hale, 1954).



**20. *Lecidea (Psora) decipiens* (Ehrh.) Ach.**

On moist calcareous clay, Upper Dumbbell Lake (35889b).

**21. *Lecidea despecta* T. Fr.**

On pebbles on calcareous clay-shale, in damp moss-tundra, Cape Belknap (35286). On calcareous moss-tundra and rocky clay slopes on W. side of The Dean (35426). On moist gravel and clay slope at edge of the Arctic Ocean, W. of Cape Belknap (35801a).

This species was originally described by Fries (1879) from Ellesmere Island (Grant Land).

**22. *Lecidea dicksonii* Ach.**

Camp Ravine, Hilgard Bay (35916).

The only collection of this usually common arctic species.

**23. *Lecidea elata* Schaer.**

On rocks in dry saxifrage barrens, just W. of Alert (35850).

**24. *Lecidea ementiens* Nyl.**

On loose scree on the SW. slopes of Mt. Pullen (35767e).

**25. *Lecidea goniophila* Flk.**

On rocks on clayey, calcareous low areas near ponds between Parr Inlet and Upper Dumbbell Lake (35864a). With *Lecanora polytropa*, Camp Ravine, Hilgard Bay (35918).

**26. *Lecidea lapicida* Ach.**

On stones on gravel and clay slope at edge of Arctic Ocean W. of Cape Belknap (35807); on stones on moist calcareous clay, Upper Dumbbell Lake (35892, 35899).

**26a. *Lecidea lapicida* fo. *ecrustacea* (Bausch) Anzi**

On rocks on dry saxifrage barrens just W. of Alert (35845a).

**27. *Lecidea lulensis* (Hellb.) Stiz.**

On rocks on rocky clay slopes, W. slope near base of The Dean (35417c).

Formerly known from as far north as Arctic Bay (Lynge, 1947).

**28. *Lecidea magna* Lynge**

On rocks on gravel and clay slope at edge of Arctic Ocean W. of Cape Belknap (35810). Described by Lynge (1937) from S. Greenland.

New to the Canadian Eastern Arctic.

**29. *Lecidea occidentalis* Lynge**

On rocks on dry saxifrage barrens just W. of Alert (35845).

The tinge of violet mentioned by Lynge (1937) is perfectly apparent in the hymenium which is dark olivaceous, as is the hypothecium.

New to the Canadian Eastern Arctic. Described from Greenland.



**30. *Lecidea picea* Lynge**

With *Rhizocarpon superficiale* ssp. *boreale* on a rock, on the southwest slopes of Mt. Pullen (35751b).

Lynge (1940) has reported this from widely scattered regions in the Arctic, including SE. Greenland. New to the Canadian Eastern Arctic.

**31. *Lecidea stigmatea* Ach.**

On rocks on W. slope near base of The Dean, in moist calcareous moss-tundra (35426a). On rocks, on moist gravel and clay slope at edge of Arctic Ocean, W. of Cape Belknap (35801b).

Reported from Baker Lake by Lynge (1935) but not previously from the Arctic Archipelago.

**32. *Lecidea vernalis* (L.) Ach.**

In dry saxifrage barrens, on point at the W. side of Ravine Bay (35941).

**33. *Bacidia alpina* (Schaer.) Vainio**

On moist clay slopes near tip of Cape Belknap, at edge of Lincoln Sea (35752).

A considerable extension of range for this rarely collected species. Lynge (1947) reports this species from Port Burwell in Northern Burwell.

**34. *Toninia caeruleonigricans* (Lightf.) T. Fr.**

On rocks, on moist gravel and clay slope at edge of Arctic Ocean, W. of Cape Belknap (35811a). On dry saxifrage barrens, just W. of Alert (35848a).

This species has been previously reported from as far north as Baffin Island (35848a).

**35. *Rhizocarpon disporum* (Naeg.) Müll. Arg.**

On rocks on moist clay slopes, at edge of Lincoln Sea, Cape Belknap (356276, 35628). On dry saxifrage barrens just W. of Alert (35852); Camp Ravine, Hilgard Bay (35921, 35923).

**36. *Rhizocarpon jemtlandicum* Malme**

On E. slope of Mt. Pullen on rocky, steeply sloping, weakly or hardly calcareous scree slopes (35319a).

Previously reported as far north as northern Baffin Island.

**37. *Rhizocarpon subtile* Runem.**

On W. slope near the base of The Dean, on moist calcareous moss-tundra and rocky clay slopes (35415b). On rocks in moist, calcareous clay, Upper Dumbbell Lake (35896).

This species with red subhymenium, indistinct prothallus, muriform spores and an I — reaction of the medulla, was described from southwestern Greenland.

**38. *Rhizocarpon superficiale* (Schaer.) Malme ssp. *boreale* Runem.**

On rocks on gravel and clay slope at edge of Arctic Ocean, W. of Cape Belknap (35801). On rocks on dry saxifrage barrens, just W. of Alert



(35842). On W. slope near the base of The Dean, on moist calcareous moss-tundra and rocky clay slopes (35417). On rocks on moist clay slopes, at edge of Lincoln Sea, 1 to 2 miles W. of tip of Cape Belknap (35627a). Runemark (1956) quotes localities in Ellesmereland at Harbour Bay and Gansefjord collected by Simmons.

This segregate from the yellow *Rhizocarpons* has small uniseptate spores, a dark epihymenium, white medullary tissue between the subhymenium and the prothallus and a dull, sooty disc. The Runemark monograph is a splendid contribution to our understanding of the yellow *Rhizocarpons*.

**39. *Rhizocarpon tinei* (Tornab.) Runem. ssp. *arcticum* Runem.**

On E. slope of Mt. Pullen, on rocky, steeply sloping scree slopes (35319).

This species has already been reported from Ellesmere Island by Runemark on the basis of collections by Simmons.

### CLADONIACEAE

**40. *Cladonia pyxidata* (L.) Hoffm.**

Just W. of Alert on dry saxifrage barrens (35848b). On W. and NW. slopes of The Dean, on calcareous moss-tundra (35163). Camp Ravine, Hilgard Bay (35922a). The last specimen is var. *pocillum* (Ach.) Flot.

**41. *Stereocaulon glareosum* (Sav.) H. Magn. var. *brachyphylloides* M. Lamb**

On low, calcareous scarp at edge of persistent snowfield, one-quarter mile N. of Mt. Pullen (35365).

This species has been reported as far north as Baffin Island by Hale. The variety was described by Lamb in Llano (1951) from Alaskan material. It is hitherto unlisted from the Canadian Eastern Arctic. I am much indebted to Dr. I. M. Lamb for the determination of this material.

The paucity of material from both the *Cladoniae* and the *Stereocaulons* in this collection seems rather significant. They must be rather rare near Alert.

### UMBILICARIACEAE

**42. *Omphalodiscus virginis* (Schaer.) Schol.**

On W. slope near base of The Dean (35429).

Determination kindly supplied by Dr. P. F. Scholander. This species has already been reported from Ellesmere by Fries.

**43. *Umbilicaria lyngei* Schol.**

On loose scree, SW. slopes of Mt. Pullen (35746). On W. slope near the base of The Dean, on rocky clay slopes (35423a, 35417). On scree slope 9 to 10 miles W. of Peak 1, the farthest west attained toward the U.S. Range (35609a). On loose scree on the SW. slopes of Mt. Pullen (35749e). On rocky, steeply sloping, weakly calcareous scree slopes on the E. slope of Mt. Pullen (35319).



Again I am much indebted to Dr. Scholander for the determinations of these specimens. Lynge (1947) discusses the possible records of this species from Ellesmere with some reservations which are now not necessary.

#### ACAROSPORACEAE

**44. *Sporostatia testudinea* (Ach.) Mass.**

Camp Ravine, Hilgard Bay, on schist with *Lecidea dicksonii* (35917).

**45. *Acarospora scabrida* (Hedl.) Magn.**

On schistose, noncalcareous slate, in deep ravine on the S. side of Hilgard Bay (35903).

Previously reported by Lynge from W. and NE. Greenland; new to the Canadian Eastern Arctic.

**46. *Sarcogyne simplex* (Dav.) Nyl.**

In dry saxifrage barrens just W. of Alert (35844). On rocks on moist clay slope, Cape Belknap, about 1 to 2 miles W. of the tip at the edge of the Lincoln Sea (35630).

#### PERTUSARIACEAE

**47. *Pertusaria dactylina* (Ach.) Nyl.**

On dry scree slopes near the summit of The Dean (35391b).

The northernmost previous report was on Baffin Island.

**48. *Pertusaria freyi* Erichs. var. *monosticha* Erichs.**

On dry saxifrage barrens just W. of Alert (35849a).

New to North America.

**49. *Pertusaria oculata* (Dick.) T. Fr.**

On dry scree slopes near the summit of The Dean (35398b). On moist, calcareous, moss-tundra slopes on the W. and NW. slopes of The Dean (35163b).

Previously known north to Baffin Island.

#### LECANORACEAE

**50. *Lecanora behringii* Nyl.**

On noncalcareous rotting schist and slate ledges in deep ravine on the S. side of Hilgard Bay (35904).

Known from Baffin Island, Hudson Bay, Greenland, and Bering Sea region.

**51. *Lecanora (Aspicilia) candida* (Anzi) Nyl.**

On moist calcareous clay, Upper Dumbbell Lake (35898).

**51a. *Lecanora candida* var. *nikrapensis* (Darb.) Zahlbr.**

On dry saxifrage barrens just W. of Alert (35851). Camp Ravine, Hilgard Bay (35918a). On calcareous clay shale in damp moss-tundra, Cape Belknap (35286a).



Previously reported from Greenland; new to the Canadian Eastern Arctic.

**52. *Lecanora cladonioides* Lynge**

On moist gravelly and clayey slope at the edge of the Arctic Ocean,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35805, 35811). On moist calcareous clay, Upper Dumbbell Lake (35891).

This species was described by Lynge (1940) from NE. Greenland as a new species. New to the Canadian Eastern Arctic.

**53. *Lecanora congesta* Lynge**

On dry saxifrage barrens just W. of Alert (35842b). With *Physcia sciastra* and *Rhizocarpon superficiale* ssp. *boreale* on rocks.

Described by Lynge (1940) from NE. Greenland as a new species *ad. int.* It is new to the Canadian Eastern Arctic.

**54. *Lecanora dispersa* (Pers.) Flk.**

On rocks on moist gravelly and clayey slopes  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35808).

**55. *Lecanora epibryon* Ach.**

On calcareous, moist moss-tundra slopes on the W. and NW. slopes of The Dean (35164, 35189d). On calcareous, clay-shale, damp moss-tundra, Cape Belknap (35284c). On moist gravel and clay slope at edge of the Arctic Ocean, W. of Cape Belknap (35805e, 35812). On dry saxifrage barrens just W. of Alert (35848, 35849). On moist calcareous clay, Upper Dumbbell Lake (35884, 35895a). Camp Ravine, Hilgard Bay (35925).

**56. *Lecanora flavida* Hepp.**

On rocks on calcareous clay-shale slope at S. end of Hilgard Bay (35246b).

**57. *Lecanora melanophthalma* Ram.**

On rocky, clayey moss-tundra in valley between Peak 1 and Peak 2 (35544).

**58. *Lecanora narssaqensis* Lynge**

On dry saxifrage barrens just W. of Alert (35850).

This species was described as a new species from W. Greenland by Lynge (1937). It is new to the Canadian Eastern Arctic.

**59. *Lecanora perradiata* Nyl.**

On rocks on gravel and clay slope  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35804).

**60. *Lecanora polychroma* (Anzi) Nyl. var. *pallescent* (Anzi) Stur.**

On moist, calcareous clay, Upper Dumbbell Lake (35897).



This keys to this species in Magnusson's monograph of the *Aspicilia gibbosa* group (1939), but for lack of comparative material I cannot be certain of the identification of this species which has been reported from Novaya Zemlya.

**61. *Lecanora polytropa* (Ehrh.) Rabh.**

On noncalcareous rotting schist and slate ledges in deep ravine on S. side of Hilgard Bay (35905).

**61a. *Lecanora polytropa* fo. *illusior* (Ach.) Leight.**

On scree at 1,000 feet, The Dean (35423b).

**62. *Lecanora verrucosa* (Ach.) Laur.**

On scree slope 9 to 10 miles W. of Peak 1 (35610c). On rocks on moist calcareous clay, Upper Dumbbell Lake (35895b). On rocks on moist calcareous moss-tundra and rocky clay slopes on W. slope near the base of The Dean (35427a).

**63. *Ochrolechia frigida* (Sw.) Lynge**

On noncalcareous, rotting schist and slate ledges in deep ravine on the S. side of Hilgard Bay (35906). Only the sterile thallus present. On gravel and clay slope at edge of Arctic Ocean, W. of Cape Belknap (35813).

**64. *Haematomma ventosum* (L.) Mass. var. *lapponicum* (Räs.) Lynge**

On loose scree on the SW. slopes of Mt. Pullen (35757a). On scree at 1,000 feet on The Dean (35423).

**65. *Candelariella aurella* (Hoffm.) Zahlbr.**

On rocky clay slopes on W. slope near base of The Dean (35415d). On gravel and clay slope at edge of Arctic Ocean, W. of Cape Belknap (35804a). On soil among mosses in deep ravine on S. side of Hilgard Bay (35908).

**66. *Candelariella dispersa* (Räs.) Hakul.**

On thallus of *Placynthium*, on moist clay slopes at edge of Lincoln Sea, 1 to 2 miles from the tip of Cape Belknap (35629). On moist calcareous clay, Upper Dumbbell Lake (35889c).

**67. *Candelariella placodizans* (Nyl.) Magn.**

On calcareous clay shale in damp moss-tundra, Cape Belknap (35284a).

## PARMELIACEAE

**68. *Parmelia alpicola* T. Fr.**

On loose scree on SW. slopes of Mt. Pullen (35748). Not previously reported north of Baffin Island.

**69. *Parmelia exasperatula* Nyl.**

On W. slope near the base of The Dean (35429b). Previously reported on Baffin Island by Hale; a northern record for this species.



**70. *Parmelia omphalodes* (L.) Ach.**

On scree slope 9 to 10 miles W. of Peak 1 (35609).

**71. *Parmelia stygia* (L.) Ach.**

On moist clay slopes at edge of Lincoln Sea, 1 to 2 miles from tip of Cape Belknap (35749d).

**72. *Parmelia subobscura* Vainio**

In dry rock field and saxifrage barrens on the W. slope of Peak 1 (35525). On loose scree on SW. slopes of Mt. Pullen (35746b). Dry saxifrage barrens, point on west side of Ravine Bay (35941).

**73. *Cetraria cucullata* (Bell) Ach.**

On calcareous moss-tundra slopes in rich firn-ice slopes on W. and NW. slopes of The Dean (35164b). On loose scree on SW. slopes of Mt. Pullen (35721a).

**74. *Cetraria delisei* (Bory) T. Fr.**

On calcareous moss-tundra slopes fed by permanent firn-ice, W. and NW. slopes of The Dean (35165). On loose scree on SW. slopes of Mt. Pullen (35749b).

**75. *Cetraria hepatizon* (Ach.) Vainio**

On moist calcareous moss-tundra and rocky clay slopes on W. slope near the base of The Dean (35416, 35423d). On loose scree on SW. slopes of Mt. Pullen (35746a, 35750).

**76. *Cetraria islandica* (L.) Ach.**

On calcareous moss-tundra slopes fed by permanent firn-ice, W. and NW. slopes of The Dean (35164a). On rocky, clayey moss-tundra on stable slopes in valley between Peak 1 and Peak 2 (35544b). On scree slope 9 to 10 miles W. of Peak 1 (35607). On loose scree on SW. slopes of Mt. Pullen (35746c).

**77. *Cetraria nivalis* (L.) Ach.**

On calcareous moss-tundra slopes in rich firn-ice valleys on W. and NW. slopes of The Dean (35173b). In dry rock field and saxifrage barrens on W. slope of Peak 1 (35526). In dry saxifrage barrens on point on W. side of Ravine Bay (35941b).

## USNEACEAE

**78. *Dactylina ramulosa* (Hook.) Tuck.**

On calcareous moss-tundra slopes in rich firn-ice valleys on W. and NW. slopes of The Dean (35165a).

**79. *Cornicularia aculeata* (Schreb.) Ach.**

On calcareous moss-tundra in rich firn-ice valleys on W. and NW. slopes of The Dean (35165b).



**79a. *Cornicularia aculeata* var. *muricata* Ach.**

On dry rock field and saxifrage barrens on W. slope of Peak 1 (35524).  
On dry saxifrage barrens just W. of Alert (35841).

**80. *Cornicularia divergens* Ach.**

On loose scree on SW. slopes of Mt. Pullen (35721).

**81. *Alectoria cincinnata* (Fr.) Lynge**

On dry rock field and saxifrage barrens on W. slope of Peak 1 (35523).

**82. *Alectoria minuscula* Nyl.**

On rocky clay slopes in moist calcareous moss-tundra on W. slope near the base of The Dean (35416a). Camp Ravine, Hilgard Bay (35924).

**83. *Alectoria nigricans* (Ach.) Nyl.**

On loose scree on SW. slopes of Mt. Pullen (35751a, 35789). On scree slope 9 to 10 miles W. of Peak 1 (35610).

**84. *Alectoria ochroleuca* (Ehrh.) Ach.**

On rocky, steeply sloping, weakly or hardly calcareous scree slopes on E. slope of Mt. Pullen (35319). On loose scree on SW. slopes of Mt. Pullen (35749d). On calcareous moss-tundra in rich firn-ice valleys on W. and NW. slopes of The Dean (35187).

**85. *Alectoria pubescens* (L.) Howe, Jr.**

On calcareous moss-tundra and rocky clay slopes on W. slope near the base of The Dean (35423c). On scree slope 9 to 10 miles W. of Peak 1 (35607b, 35609b). On rocky scree slopes on E. slope of Mt. Pullen (35320).

**86. *Alectoria vexillifera* (Nyl.) Stiz**

In dry saxifrage barrens on point on W. side of Ravine Bay (35941a).

**87. *Thamnotia vermicularis* (Sw.) Ach.**

On calcareous moss-tundra in rich firn-ice valleys on W. and NW. slopes of The Dean (35164c, 35165c, 35173a). On rocky, clayey moss-tundra on stable slopes in valley between Peak 1 and Peak 2 (35544a). On loose scree on SW. slopes of Mt. Pullen (35749c). On moist gravel and clay slope at edge of Arctic Ocean  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35812a). In dry saxifrage barrens on point on W. side of Ravine Bay (35941c).

## CALOPLACACEAE

**88. *Blastenia tetraspora* (Nyl.) Rehm.**

On scree slope 9 to 10 miles W. of Peak 1 (35610b). On loose scree on SW. slopes of Mt. Pullen (35765b).

**89. *Fulgensia bracteata* (Hoffm.) Räs.**

On moist, calcareous moss-tundra and rocky clay slopes on W. slope near base of The Dean (35428). On dry saxifrage barrens just W. of Alert (35848c). On moist calcareous clay, Upper Dumbbell Lake (35895, 35885).



90. *Caloplaca cirrochroa* T. Fr.

On noncalcareous rotting schist and slate ledges in deep ravine on S. side of Hilgard Bay (35907).

I cannot be certain of the determination as the thallus is sterile, but it compares very favourably with the thallus of this species. If this report is substantiated, *Caloplaca cirrochroa* is new to the Canadian Eastern Arctic.

91. *Caloplaca elegans* (Link.) T. Fr.

On rocks in moist calcareous moss-tundra and rocky clay slopes on W. slope near base of The Dean (35429d). On moist clay slopes at edge of Lincoln Sea, 1 to 2 miles W. of the tip of Cape Belknap (35627d). On moist gravel and clay slope at edge of Arctic Ocean,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35805d). On dry saxifrage barrens just W. of Alert (35843). Cliff face at S. end of Hilgard Bay (35513). On moist gravel and clay slope at edge of Arctic Ocean,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35802). In dry saxifrage barrens on point at W. side of Ravine Bay (35942).

92. *Caloplaca stillicidiorum* (Vahl) Lynge

On calcareous clay shale in damp moss-tundra, Cape Belknap (35284e).

93. *Caloplaca subolivacea* (T. Fr.) Lynge

On loose scree on SW. slopes of Mt. Pullen (35749). On moist calcareous clay, Upper Dumbbell Lake (35895c).

#### TELOSCHISTACEAE

94. *Xanthoria fallax* (Hepp.) Arn.

On calcareous clay shale in damp moss-tundra, Cape Belknap (35284b). On gravel and clay slope at edge of Arctic Ocean,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35805b).

The specimens examined have the characteristic labriform soralia of *Xanthoria fallax* rather than the more isidiate margins of *Xanthoria candelaria*. Perhaps some of the reports of the latter species in the Arctic really refer to *Xanthoria fallax*, which has not previously been reported from the Canadian Eastern Arctic.

#### BUELLIACEAE

95. *Buellia atrata* (Sm.) Anzi

On calcareous moss-tundra and rocky clay slopes on W. slope near base of The Dean (35416b).

96. *Buellia epigaea* (Pers.) Tuck.

In dry saxifrage barrens just W. of Alert (35840).

Only one apothecium was present on this specimen, which had the hypothecium brown-black, radiating into the exciple and the cortical hyphae vertical in the apothecia.



**97. Buellia geophila** (Somerf.) Lynge

On scree slope 9 to 10 miles W. of Peak 1 (35610e).

Previously reported from Lake Harbour in the Canadian Eastern Arctic by Lynge (1947).

**98. Buellia leptocline** (Flot.) Korb.

On calcareous clay shale in damp moss-tundra, Cape Belknap (35286b).

Previously reported from Devon Island in the Canadian Eastern Arctic, this is a northern record for the species.

**99. Buellia papillata** (Somerf.) Tuck.

On moist calcareous clay, Upper Dumbbell Lake (35889, 35894).  
Camp Ravine, Hilgard Bay (35925).

**100. Buellia vilis** T. Fr.

On moist calcareous clay, Upper Dumbbell Lake (35899).

Previously known only from the original collection on Ellesmereland (Fries, 1879).

**101. Rinodina mniaraea** (Ach.) Kbr. var. **normalis** T. Fr.

On calcareous moss-tundra in rich firn-ice valleys on W. and NW. slopes of The Dean (35189b).

**102. Rinodina roscida** (Somerf.) Arn.

On calcareous moss-tundra slopes in rich firn-ice valleys on W. and NW. slopes of The Dean (35163a). On moist gravel and clay slopes at edge of Arctic Ocean,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35811). In dry saxifrage barrens just W. of Alert (35847, 35849b). On clayey, calcareous, low areas near ponds between Parr Inlet and Upper Dumbbell Lake (35865). Camp Ravine, Hilgard Bay (35922b).

The apothecia in some of these are larger than usual for this ubiquitous arctic species, which in No. 35847 reach 2 mm across and have crenulate margins.

**103. Rinodina turfacea** (Wahlb.) Kbr.

On calcareous low scarp at edge of persistent snowfield,  $\frac{1}{4}$  mile N. of Mt. Pullen (35373a).

**104. Physcia caesia** (Hoffm.) Hampe

On calcareous moss-tundra and rocky clay slopes, on the W. slope near the base of The Dean (35429a). On moist clay slopes at the edge of the Lincoln Sea, 1 to 2 miles W. of Cape Belknap (35627). On moist gravel and clay slope at edge of Arctic Ocean,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35805).

**105. Physcia constipata** (Nyl.) Norrl. & Nyl.

On calcareous clay shale, damp moss-tundra, Cape Belknap (35284d).  
Not previously reported N. of Baffin Island.



**106. *Physcia dubia* (Hoffm.) Lettau**

On moist clay slopes at edge of Lincoln Sea, 1 to 2 miles W. of tip of Cape Belknap (35627). On gravel and clay slope at edge of Arctic Ocean  $1\frac{1}{2}$  to  $2\frac{1}{2}$  miles W. of Cape Belknap (35805). In dry saxifrage barrens on point at W. side of Ravine Bay (35942a).

**107. *Physcia muscigena* (Ach.) Nyl.**

On calcareous moss-tundra slopes in rich firn-ice valleys on W. and NW. slopes of The Dean (35166, 35173). On calcareous moss-tundra and rocky clay slopes on W. slope near the base of The Dean (35427—unusually robust, 35429c). On loose scree on SW. slopes of Mt. Pullen (35749a).

**107a. *Physcia muscigena* fo. *squarrosa* (Ach.) Lynge**

On calcareous clay shale in damp moss-tundra, Cape Belknap (35284).

#### LICHENES IMPERFECTI

**108. *Crocynia neglecta* (Nyl.) Hue**

On noncalcareous rotting schist and slate ledges in deep ravine on S. side of Hilgard Bay (35914).



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A. "Camp Ravine" at the south end of Hilgard Bay, showing residual snowbanks in early August, and sterile, dry, loose to slightly incorporated scree slopes. At the right, snow-fed slopes proved rich in *Hepaticae*, *Cryptocolea imbricata*, *Lophozia quadriloba*, *L. heterocolpa harpanthoides*, and numerous other species occurring there.



B. South end of Hilgard Bay, showing residual sea-ice in early August, and remnants of hanging snowbanks; below these a well-developed moss-tundra occurred (darker areas in photograph).





A. South end of Hilgard Bay, showing residual bay-ice in early August. In the distance the head of Hilgard Creek and Hilgard Valley. Note early (but persistent) fresh snow at elevations above 500 feet, and firn-ice-filled valley near upper right. Much of the best collecting was done near the mouth of such firn-ice-filled valleys, where permanently irrigated sites occurred.



B. Dumbbell Bay, showing gravelly beach in foreground, devoid of all bryophytes. The plateau in the distance shows permanent snowbanks (photograph made August 21) below which occurred many calciphilous Hepaticae, among them *Athalamia hyalina*, *Sauteria alpina*, *Trichostylium pinguis*, *Lophozia pellucida*, *Preissia quadrata*.





A. Stony, sterile barrens to the north of Mt. Pullen, which is in the background. Note the permanently snow-filled valleys of Mt. Pullen, below which many of the better collecting sites occurred. Here were found, i.e., *Gymnomitrium corallioides*, *Cryptocolea imbricata*, *Anthelia juratzkana*, *Lophozia quadriloba*, *L. opacifolia*, *L. alpestris major*, *L. latifolia*, *L. excisa*, *Odontoschisma macounii*, and *Ptilidium ciliare*. Near the summit occurred various *Rhacomitria* and *Grimmia* species, and *Gymnomitrium corallioides*.



B. Shallow valley, filled with firn-ice, at the lower right a grass-moss-tundra slope, irrigated by melt-water. Such grass-moss-tundra was, in all cases, highly calcareous and usually consisted of the commoner, more "weedy" species; among Hepaticae, only *Scapania gymnostomophila*, *Cephaloziella arctica*, and *Blepharostoma trichophyllum brevirete* were to be found; among mosses, the genera *Encalypta*, *Dislichium*, *Ditrichum*, *Timmia*, and others were represented.



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